

St. Petersburg University
Graduate School of Management

Master in Management Program

BOARD OF DIRECTORS' INTELLECTUAL CAPITAL AS DRIVER OF FIRM
PERFORMANCE IN INNOVATIVE COMPANIES

Master's Thesis by the 2nd year student

Concentration — General Track

Berezkin Kirill

Research advisor: Irina V. Berezinets, Associate Professor

St. Petersburg

2018

АННОТАЦИЯ

Автор	Берёзкин Кирилл Вадимович
Название ВКР	Интеллектуальный капитал совета директоров как драйвер результативности инновационных компаний
Образовательная программа	«Менеджмент» (Master in Management – MiM)
Направление подготовки	Менеджмент
Год	2018
Научный руководитель	Березинец Ирина Владимировна, к. ф.-м. н., доцент кафедры финансов и учёта
Описание цели, задач и основных результатов	<p>Целью данной работы являлось изучение взаимосвязи между интеллектуальным капиталом совета директоров и результативностью деятельности инновационных компаний. В ходе достижения этой цели был выполнен ряд задач:</p> <ol style="list-style-type: none"> 1) Дано определение понятия «инновационная компания», а также выбран соответствующий цели показатель инновационной активности. 2) Обоснована взаимосвязь между инновационной активностью и результативностью фирмы 3) Проанализирована нормативная база российского законодательства, классическая и современная научная литература, посвящённая деятельности совета директоров в российских публичных компаниях. 4) Исследован термин «интеллектуальный капитал совета директоров» определены его основные элементы. 5) Теоретически обоснована модель исследующая взаимосвязь между интеллектуальным капиталом совета директоров и инновационной активностью. 6) Проведено эмпирическое исследование взаимосвязи интеллектуального капитала совета директоров и результативностью инновационных компаний. <p>В качестве основных результатов можно выделить следующие:</p> <ol style="list-style-type: none"> 1) Установлена нелинейная взаимосвязь между сроком пребывания директора в совете и результативностью деятельности инновационной компании; 2) Обнаружена нелинейная взаимосвязь между числом позиций неисполнительного директора в других советах директоров и результативностью деятельности инновационной компании; 3) Подтверждена гипотеза о линейно взаимосвязи между продвинутой технологической экспертизой директора и результативностью деятельности инновационной компании
Ключевые слова	Совет директоров, интеллектуальный капитал, инновационная компания, результативность деятельности

ABSTRACT

Master Student's Name	Berezkin Kirill
Master Thesis Title	Board of Directors' Intellectual Capital as Driver of Firm Performance in Innovative Companies
Educational Program	Master in Management - MiM
Main field of study	Management
Year	2018
Academic Advisor's Name	Irina V. Berezinets, Candidate of Science (Physics and Mathematics), Associate Professor
Description of the goal, tasks and main results	<p>The main goal of the study is to investigate the relationship between board's intellectual capital and firm performance in innovative companies.</p> <p>In the course of writing the paper, the following interim tasks were completed:</p> <ol style="list-style-type: none"> 1) Defined the term "innovative company" and chosen the most adequate indicator of innovation activities. 2) Justified the relationship between innovation activities and firm performance. 3) Analyzed regulatory base of Russian legislation, classic and modern scientific literature dedicated to the activities of board of directors in Russian public companies. 4) Analyzed the term board of directors' intellectual capital and elements of which it consists. 5) Theoretically substantiated the model for investigating relationship between board's intellectual capital and innovation activities. 6) Conducted an empirical study of relationship between board of directors' intellectual capital and firm performance in innovative companies. <p>Among the main results of the study the following ones should be distinguished:</p> <ol style="list-style-type: none"> 1) Found nonlinear relationship between board's tenure and firm performance in innovative companies; 2) Obtained nonlinear relationship between multiple directorships of nonexecutive directors in innovative companies and firm performance in innovative companies; 3) Discovered that advanced technological expertise is positively related to firm performance in innovative companies.
Keywords	Board of directors, intellectual capital, innovative company, firm performance

TABLE OF CONTENTS

Introduction.....	5
1. Innovations in Russian companies	8
1.1. The term “innovative company”	8
1.2. Why do companies need innovations?.....	14
1.3. Innovations and company’s performance	20
First chapter conclusions	25
2. Board of directors’ intellectual capital.....	27
2.1. Board of directors as a major internal corporate governance mechanism.....	27
2.2. Main elements of board’s intellectual capital	31
2.3. Relationship between board’s intellectual capital and innovations.....	37
Second chapter conclusions	44
3. Empirical study of relationship between board’s intellectual capital and firm performance.....	45
3.1. Methodology and sampling	45
3.2. Econometric analysis	51
3.3. Analysis of results.....	64
Conclusion	68
Bibliography	70
Appendices	82

INTRODUCTION

The following research is dedicated to investigation of relationship between board of directors' intellectual capital and firm performance of innovative Russian public companies.

In recent years a lot of attention has been paid to innovation in Russia. In 2010 Russian president issued an order about establishing innovation center "Skolkovo" – scientific and technological innovation complex for development and commercialization of new technologies (Federal Law from 29.09.2010 N 244-FL" 2018). In 2011 the Strategy for innovation development of Russia till 2010 was accepted (Federal Law from 26.05.2011 N 208-FL 2018). In May of 2016 Open government suggested to several ministries decreasing tax burden for companies investing in R&D. In particular it was offered to deduct twice amount of R&D expenses from companies' income tax fiscal base and to cancel intellectual property tax (Vedomosti 2016). Those steps were triggered by the dramatic fall in oil prices, which significantly decreased income of natural resources export counting for the major part of Russian national budget. Moreover, the change in market situation because of the EU and the USA sanctions against Russia seriously depreciated Russian ruble, and thus the prices for hi-tech equipment imported from abroad increased greatly. In order to shift the economy from exporting natural resources to producing hi-tech equipment comparable to Western analogues, innovation activities are needed. This way, companies involved in innovation activities become the drivers of Russian national economy.

However, establishing innovation policy is a strategic dimension of company's activities, which according to the Russian law in public companies is supervised by board of directors. This corporate body takes decisions about key strategic aspects, including innovation policy and particularly R&D investments. For example, PJSC Gazprom in its annual report in 2014 announced that the company's board of directors that year allocated an unprecedented sum of money for R&D investments – 10.82 bln rubles (PJSC Gazprom Board of Directors report 2018).

At the same time experts state that in comparison with companies in other countries Russian ones significantly underinvest in innovations. Since board makes collegial decision, but each of directors contributes in accordance with his or her own educational background, experience in the company and industry, knowledge about the field, information obtained through networks of contacts or in other words, board's intellectual capital, it is logical to suppose that board's capital is related to innovation activities. However, it raises a question how is board's intellectual capital related to innovation activities?

Simultaneously effect from innovation activities in spite of state support is not so clearly related to firm performance. For instance, having invested 3.5 bln rubles in R&D in 2013 OJSC AVTOVAZ at the end of financial year obtained negative profits of almost 7 bln rubles (Financial report of OJSC AVTOVAZ for 2013, 2018). It provokes another question of how are innovation activities related to firm performance?

Combining both questions we may formulate research problem in the following way: how board's intellectual capital is related to firm performance in innovative companies? Thus, the main objective of this research is to find the relationship between board's intellectual capital and firm performance in innovative companies. The object of the research, this way, is innovative Russian public companies. The subject of the paper is the relationship between board's intellectual capital and firm performance.

As interim tasks needed to be resolved to reach the goal, the following ones can be identified:

- 1) To define the term “innovative company” and choose the most adequate indicator of innovation activities.
- 2) To justify the relationship between innovation activities and firm performance.
- 3) To analyze regulatory base of Russian legislation, classic and modern scientific literature dedicated to the activities of board of directors in Russian public companies.
- 4) To analyze the term “board of directors’ intellectual capital” and elements of which it consists.
- 5) To theoretically substantiate the model for investigating relationship between board's intellectual capital and innovation activities.
- 6) To conduct an empirical study of relationship between board of directors’ intellectual capital and firm performance in innovative companies.

The paper is structured in accordance with the tasks described above and consists of introduction, three chapters, conclusion, bibliography and appendices.

The first chapter is dedicated to the identification of the term “innovative company”. It analyzes different indicators allowing to define company as innovative and chooses the most adequate for the research purpose. Also this chapter shows the purpose of innovation activities for companies and states hypothesis about relationship between innovation activities and firm performance.

In the second chapter, firstly, the board's functions are analyzed in the dimensions of resource dependence theory, agency theory and from legal point of view. Moreover, this chapter explains the notion “intellectual capital” for the firm as whole and specifically for the board of directors, as well as it describes the main elements of which it consists. Finally, it makes an

analysis of researches dedicated to investigation of relationship between board of directors' intellectual capital and innovation activities.

The third chapter is devoted to empirical research itself. It describes the methodology used and sampling. Moreover, the analysis of descriptive statistics and regression analysis are conducted in the chapter, which allow to take decisions regarding acceptance or rejection of hypotheses. Finally, based on results practical managerial implications are made in this chapter.

The research is conducted on the sample of Russian public companies that invested in R&D in the period from 2010 to 2014. As for the sources of data, all the information was gathered from company's annual and quarterly reports which are publicly available. In order to conduct econometric analysis the statistic software "Stata" was used.

As a result of the research it was found that there is nonlinear relationship between board's tenure and firm performance, which means that maximum value of performance is achieved, when board's tenure reaches 4.5 years. Moreover, it was discovered that there is nonlinear relationship between multiple directorships of nonexecutive directors and firm performance, which implies that maximum value of performance is reached, when number of directors' positions on other boards achieves 5. Thirdly, it was obtained that advanced technological expertise of board members is positively related to firm performance of innovative Russian companies.

1. INNOVATIONS IN RUSSIAN COMPANIES

1.1. The term “innovative company”

In order to define “innovative company” it is logical to start with the term “innovation”, on which it is based. The first definition of innovation was cited by J. Schumpeter in his book “Theory of economic development”. He stated that innovations are commercialization of new combinations based on either:

- 1) new product or service creation;
- 2) new manufacturing way, which also involves new ways of products commercialization;
- 3) new materials and components usage;
- 4) new markets entering;
- 5) new organizational forms establishment (Backhaus and Schumpeter 2003).

This way, the term “innovation” includes two components: technological one in form of new product or new way of manufacturing and business one in form of commercialization of invention. It is worth noticing that from Schumpeter’s point of view “innovation” should not be perceived only from technical side and that this term is much broader than that.

Even broader “innovation” was defined by P. Drucker who stated that “innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service” (Drucker 2014). Describing innovation more as process not result P. Drucker expresses the idea that lies behind innovation, which, unfortunately, does not allow comprehending the notion itself.

Not only P. Drucker tried to define innovation in his own way. Having investigated the topic, we discovered in every research or theoretical paper (Prazdnichnykh 2013; Malysheva, Shestakov 2012, Yudanov 2012) the author’s own interpretation of this term. However, most of contemporary definitions of innovation derive from Oslo manual being the slight variations of it with personal researchers’ addition. Oslo manual proposes the division of innovations into 4 types, each of which has its own definition:

- **product innovation:** a good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.

- **process innovation:** a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
- **marketing innovation:** a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- **organizational innovation:** a new organizational method in business practices, workplace organization or external relations (Mortensen et al. 2005).

It is interesting to notice that the last terms were added to the second edition of the manual that could reflect the turn in tendency to comprehend innovations as purely technological inventions that significantly narrows down the scope of their influence and importance. One more point that should be mentioned is that under innovation these definitions consider not only truly new products and processes that have never existed before, but also the improved ones developed on the basis of the widely existing products and processes. However, the definitions do not indicate how to measure “significance” of the improvement, which as well is a disadvantage of the approach.

Being much more operational than plenty of other definitions in the literature on this topic, Oslo’s one still does not specify features, by which we can clearly identify innovation. Here we should come back to the manual that distinguishes several characteristics each innovation should have:

- 1) uncertainty: when nobody knows how much time implementation of innovation will take and whether it will be successful or not;
- 2) investments that are expressed in acquisition of fixed assets and materials, payments to workers and etc.
- 3) “turnover” under which it is implied that innovations are susceptible to imitation and borrowing;
- 4) usage of new or existing knowledge;
- 5) orientation toward increase in firm performance through obtaining competitive advantage by means of growing demand for the product or cost reduction.

We should remark that those attributes rather describe the process than result. However, previously given definition of innovation states it as a result of the process, which it is natural to call “innovation activities”. Consequently, the company, which is involved in this kind of activities becomes innovative. Taking into account that from practical standpoint the definition of innovations is still not fully clear, moreover, there are a lot of variations of it, the question arises: how to identify if the company is innovative or not and if yes, to which extent it is

involved in innovative activities. There should be the set of criteria allowing to assign the company to one category or another.

Being that simple in theory it occurred to be much more complicated in practice, since there are a lot of conflicting points of view and personal interpretations of those criteria. For example, (Balashov et al. 2010) under innovation activities understand complex subject that includes:

- sensitivity towards technical and organizational novelties;
- degree of intensity and timeliness of actions aimed at creation, implementation and commercialization of novelties;
- ability to mobilize financial, scientific, technological and human potential of necessary amount and quality;
- ability to substantiate applied methods;
- rationality of innovation process technology in terms of content and sequence.

In other words, innovation activities describe readiness to update major elements of innovation system – knowledge, equipment, communication technologies and infrastructure for their efficient usage”. The obvious advantage of the definition is that it is detailed; however, it is far away from being used in practice. Nevertheless, it should be stressed that the whole way of how that definition is formulated points at subjective nature of the term that it explains. We find the substantiation of this guess further, when the authors cite “main indicators” characterizing the level (but not the fact of presence) of innovative activities:

- R&D investments share in total expenses;
- portion of innovative production in total volume;
- share of R&D employees in company’s personnel structure;
- relation between acquired and sold technologies;
- coefficient of intellectual property commercialization;
- efficiency of R&D expenses”(Balashov et al. 2010).

If we refer to Oslo manual that has saved us before, we discover that technological product and process innovation activities, with which it deals, are identified as “all those scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of technologically new or improved products or processes” (Mortensen et al.2005) that actually is very consequent with the innovation definition given before, but again is totally non-operational.

In another fundamental international document concerning innovations that is called Frascati Manual the following model is cited:

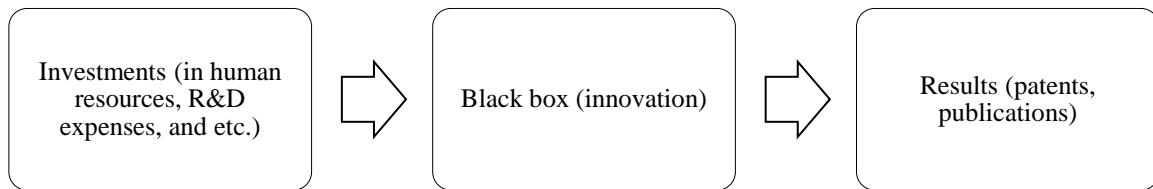


Figure 1. Linear model of innovation (Frascati 2002)

It confirms logical guess that patents and publications documenting results of innovative process executed by company can be counted as an evidence of innovative company. However, vice versa, their absence does not indicate that the company is not innovative. Coming back to Oslo manual we find that “during the examination period firms can be involved in innovative activities without having implemented any innovation yet. All kinds of forms related to innovation development and implementation including innovations, whose exploitation is planned to do in future are regarded as innovation activities. Consequently, the firm that was doing some innovation activities in the period of research is innovative. This way, all the firms that try to achieve innovations through all kind of activities regardless of the results are classified as innovative” (Mortensen et al.2005).

Later the manual makes one more important comment: “innovative status of the firm can be identified through several ways. They mainly depend on research goals” (Mortensen et al.2005). This way, Oslo manual leaves it up to researchers to develop criteria, according to which the company is classified as innovative or not, and there is again not universally used approach to it.

If to talk about Russian standard regulation concerning innovation activities, we can find that “innovation activities are estimated (again not “identified”) by the main characteristics:

- possession of finished innovations;
- the level of company’s participation in innovations’ development;
- detection of main reasons for innovations activities’ absence” (State Statistics of Russia 2002).

This way, we can conclude that the Instruction relies on Frascati’s point of view, considering the fact of obtaining finished innovations as the main identifier of company’s innovative status. Later it specifies that the examination period, during which a firm should have finished innovations, is three years. However, if to read the innovation definition cited in the Instruction, it fully repeats the one given in Oslo manual, which sticks to the approach of innovative companies’ identification not related to finished innovations. We follow this approach

as well. This way, it is still unclear how to identify, whether the company is innovative or not if there are not patents or publications.

The next natural direction, which is worth exploring in search of an answer for the problem is to understand, what is implied by “innovative activities”. It is logical to reckon, first, research and development (R&D) as an inevitable part of the innovation process. However, Frascati manual mentioned above states that “R&D may or may not be part of the activity of innovation, but it is one among a number of innovation activities. These activities also include the acquisition of existing knowledge, machinery, equipment and other capital goods, training, marketing, design and software development. These innovation activities may be carried out in-house or procured from third parties” (Frascati 2002). This point of view is supported by practitioners, who state that “R&D should not be considered equal to innovations. R&D is an experimental scientific basis aimed at increasing the sum of knowledge. The process of prototypes’ testing, for example, is the one that is not included in it. Innovation activities are the set of scientific, technological, organizational, financial and commercial events” (Expert 2018). Another view on the situation from a practical point of view in Forbes claims that “successful innovations consist of R&D, values for customer and business model” (Forbes 2017). This way, we clearly see that in spite of formulating their opinions in different words both theoreticians and practitioners agree that innovation activities are various and complicated, they include R&D, but not always and not only them. In any case we can assume that there are some indicators related to each of these activities that can help to assign the company to innovative ones or not.

Virtually it occurs that in literature on the topic there are a lot of indexes and coefficients characterizing portions of innovation activities. Some of them refer to the innovative products (coefficient of equipment used in R&D purposes), others are more financial (coefficient of intellectual property provision that is calculated as a relation of intangible assets estimation towards the sum of non-current assets) etc. The researchers come up with their own set of indicators to check if the company is innovative or not. However, the most topical indicators of innovation activities are the following ones:

- number of employees involved in innovative activities;
- number of patents the company has.
- portion of R&D expenses in sales;

Among them the closest attention should be paid to the portion of R&D expenses in sales, since it is the most commonly used coefficient exploited for measuring innovation activities. From the first sight, its advantages are evident. First of all, it is rather simple to calculate, since it consists only of two parts, and the second one – sales – can be easily obtained from Profit and

Loss statement. Secondly, this indicator is based on a very simple logic that says: the more company spends on scientific research and development, the higher probability that as a result of them it will obtain innovation. However, when it comes to practice there are some flaws connected to this indicator that can significantly deteriorate its credibility. The first one concerns R&D expenses sum. The information about it might be easily gathered in European countries or the USA, but if we take Russian public companies, the data can be derived from two sources. The special item in Balance sheet called “Results of R&D” indicates capitalized expenses only on successful R&D. However, it does not reflect the whole picture, since the rest of money spent on initiatives that failed are assigned to “Other expenses” and their cumulated sum can be much bigger than those that ended successfully. Another source of information for Russian public companies regarding R&D expenses is a special section of quarterly report. Its content will be described in detail later, in the empirical part, and here we only notice that it contains the information about R&D investments made using company’s own money. In this case any kind of borrowed funds is not taken into account, which distorts the real state of affairs. The second problem with portion of R&D expenses in sales is associated with the common belief that the most beneficial innovations and cutting-edge inventions require a lot of money. However, in practice it may occur that innovations obtained through modest investment in R&D can enormously influence company’s performance results.

Regarding two other indicators, we think that their disadvantages are obvious. The number of patents the company has might not represent the scale of innovation activities it takes now to obtain innovations in the future. The number of employees involved in innovation activities, which can hardly be identified from any publicly available firm report does not reflect the quality of activities they are involved in.

The simplest outcome of this analysis is that there is no set of indicators, according to which the company can be classified as innovative. Moreover, each indicator assessing innovative activities from one side has its pros and cons that do not fit any company. Consequently, it is necessary to use indicator of innovation activities that should be selected in accordance with company’s form of legal entity, country of operating specificities, industry belonging and etc.

Drawing the conclusion of defining innovative company, we should sum up that there is no one-fits-all approach to the term “innovation”. The majority of authors rely on the definition given in Oslo manual, which divides innovation into 4 categories, giving each of them its own definition. Moreover, the company can not be identified as innovative or not solely based on the fact of possessing finished innovations. At the same time innovation activities that lead to

innovation and make company innovative can not be limited with R&D. However, the portion R&D expenses in sales is the most commonly used indicators not only to identify, if the company is innovative or not, but also to measure the scale of its innovative activities in spite of its main disadvantages. In whole, Oslo manual gives freedom in defining “innovative company” according to the purpose of the research. That is why we stick to the point of view developed by Yudanov, who states that “innovative companies vary from each other by the scale of innovation activities that should be measured with appropriate indicator” (Yudanov 2012).

1.2. Why do companies need innovations?

In the previous paragraph we so meticulously tried to define innovations and innovative companies, investigated some indicators measuring innovative activities, but did not explain what the purpose of innovation is.

Schumpeter as the founder of innovation theory proposed the idea of special innovation rents that the owner of innovation obtains. He explained that as a result of process innovation company is able to manufacture product using less resources or in other words in more cost-efficient way. Thus, firm can establish lower price on the final product and get additional money from increased demand at expense of cash flows of its competitors. In case of product innovation company becomes a monopolist that can set higher price based on the exclusivity, and this way, company acquires so-called “Schumpeterian rents” or “innovator rents” (Backhaus and Schumpeter 2003).

As can be seen, Schumpeterian approach concerns the microeconomic level, explaining innovation significance only for firms. In this sense another standpoint is presented by OECD, which thinking globally points out innovation influence on the macroeconomic level. It sees the increasing importance of innovation connected to “the knowledge-based economy” concept, according to which the most advanced economies become greatly dependent on the knowledge and information they obtain. OECD states that “nations which develop and manage effectively their knowledge assets perform better. This strategic role of knowledge underlies increasing investments in research and development, education and training, and other intangible investments, which have grown more rapidly than physical investment in most countries and for most of the last decades” (Mortensen et al.2005). However, OECD fails to connect all these activities with innovations, to creation of which all of them lead. Instead of it this conclusion is made by Oslo manual, which declares the central role of innovations in the knowledge-based economy. Moreover, Oslo manual tries to follow both firm-level and country-level approaches, developing the framework according to which there are mutual connections between firms and innovations as well as between economies and innovations. In other words, creating innovations

companies change themselves implementing these innovations as well as innovations formed under the influence of external macroeconomic factors change the environment, in which they are developed.

At the same time it is obvious that not all innovations have the same impact in terms of its significance and scale. Oslo manual offers to divide all the innovations according to their novelty into three groups:

- new to the world,
- new to the country/regions/industry,
- new to the firm (Mortensen et al.2005).

In spite of the fact that at first sight this approach deals only with the scale of innovations newness, we understand that it is implicitly related to their significance as well. Indeed, we assume that if the innovation is new to the whole world than it is probably has a great importance to all of us if not now than in future. Contrary to it, if the firm invents something new particularly to the industry, in which it operates, we do not consider this innovation as such influential. One more important outcome of this way to divide innovations is the idea that innovations should not necessarily be some global changes as internet or computer invention, as we usually perceive them. There are a lot of innovations of smaller scale, specific to particular industry, for example, of which we do not have any idea, but which allow certain companies significantly improve their operational process. This remark helps to understand, why there are so many innovative firms in the economy, sometimes in industries that are not believed to be prone to it.

If to speak about the most innovation active industries, according to the international statistics, the top five places are occupied by:

- automotive industry,
- pharmaceutical industry,
- biotechnology,
- telecommunications,
- semiconductors (Kaminskaite 2018)

However, what concerns particular country, the situation is rather different, since innovation activities performed by state institutions and private companies depend on macroeconomic and country-specific factors as it was stated earlier. For example, Russian economy is highly dependent on natural resources, and in its structure companies involved in low-tech industries prevail. Despite the fact that overall level of innovation activities in our country counts for 9.2% that is very low in comparison with other European countries (for

example, Switzerland – 60.2%, Germany - 58.9% and the UK – 45.7%), there are some particular sectors, which perform at the average European level. This way, the portion of innovative companies in chemical industry is equal to 20.4%, in metallurgy it remains at the level of 17.7%, and for engineering it reaches 20.9% (Science. Technologies. Innovations. Innovations activities 2018).

Speaking of examples, we should mention such company as PJSC Kazan'orgsinez that operates in chemical industry and is uppermost in Russia in terms of polyethylene production. Another innovative company but in metallurgy sector is PJSC MMC Norilsk Nickel, which is the biggest in Russia and one of the biggest in the world companies involved in manufacturing base metals and metals of value. PJSC AVTOVAZ represents car manufacturing industry of Russia being the leader in production of passenger cars and one of major innovators spending huge amounts of money on R&D every year.

One more peculiarity of innovative companies in Russia is that according to statistics, the majority of their innovation activities are related to renovation and modernization of manufacturing equipment, to which firms give preference in comparison with acquiring patents and licenses (Science. Technologies. Innovations. Innovations activities 2018).

To understand the reason for such state of affairs it is crucial to comprehend that logic, according to which innovative companies take actions. Basically, it all starts with defining strategic goal, company wants to achieve with its innovation policy. According to Oslo manual, there is a certain set of economic objectives:

- replace phased out products;
- extend product range;
- develop environmentally friendly products;
- maintain or increase market share;
- open up new markets (both in terms of geography and target groups);
- improve production flexibility;
- decrease production costs (by reducing unit labour costs, reject rate, product design costs, production lead times, cutting the consumption of materials and energy);
- improve product quality;
- improve working conditions;
- reduce environmental damage. (Mortensen et al.2005)

As it can be seen, the majority of those objectives are connected to product transformation or changes in production process. Only two objectives concern environmental

issues and market share. However, if it is more or less understandable how improving product quality will be able to influence company's economic results, it is totally unclear, how reducing environmental damage is associated with changing company's economic situation. It is worth noticing that there is no financial objective was included in that list. That is why, it is logical to come back to particular companies' examples in order to see what firms claim as goals of innovation process.

This way, PJSC Kazan'orsintez mentioned above claims in the quarterly report that its innovation activities serve for achieving goals that allow the company to be competitive in contemporary landscape, to develop harmonically and obtain sustainable profit. Speaking of particular directions for the innovation activities, we should distinguish: new products' manufacturing, equipment renovation, technology processes intensification, waste utilization and ecological tasks (Annual report of PJSC «Kazan'orgsintez» for 2016, 2018). PJSC MMC Norilsk Nickel stated that its investments in R&D made in 2016 were aimed at renovation and reconfiguration of refinery capacities. It also allocated significant amount of money for developing unique ways of planning mining operations. In addition to it, company highlights that it invested in reducing sulphur dioxide emissions for environmental protection (Annual report of PJSC MMC Norilsk Nickel for 2016, 2018). As for PJSC AVTOVAZ, it declares to use the results of innovation process in operational activities and for the purpose of products' promotion on internal and external markets and increase in company's competitiveness. In the whole, AVTOVAZ spent 1.3 bln. rubles for innovations in 2016 (Annual report of PJSC AVTOVAZ for 2016).

As can be seen from these examples, companies claim to use innovations to achieve various strategic goals, mainly connected to staying competitive on market through product development or increasing operational efficiency. An interesting remark is that firms state exploiting innovations to decrease harm to the environment. It seems, however, that to certain extent such steps are aimed at creating an image of socially responsible and environmentally friendly company that nowadays is very popular all over the world.

Whatever company's goals are, the body that is responsible for firm's strategy development defines them and initiates the process, making decisions about investment in R&D. If to speak about public companies, to which group the biggest firms capable of allocating huge budgets for R&D belong, such body is called board of directors. This way, board of directors defines strategic directions for R&D and establishes how much money is going to be spent on this purpose. However, this forecast is hardly accurate, since investments in R&D are very risky, because no one can be sure if the research will end successfully. Moreover, R&D investments

are long-term, for there is no guarantee, how long it will take to find something meaningful in accordance with primary strategic goal. It is not the purpose of this work to go deep into peculiarities of the innovation process itself and its complementary activities, the only thing important is that as a result of R&D eventually company obtains innovation – new or significantly improved product, process, marketing approach or organizational form. In brief the sequence of actions at this stage as well as its connection with the previous one is described by “chain-link” model (Sarri 2011) depicted below:

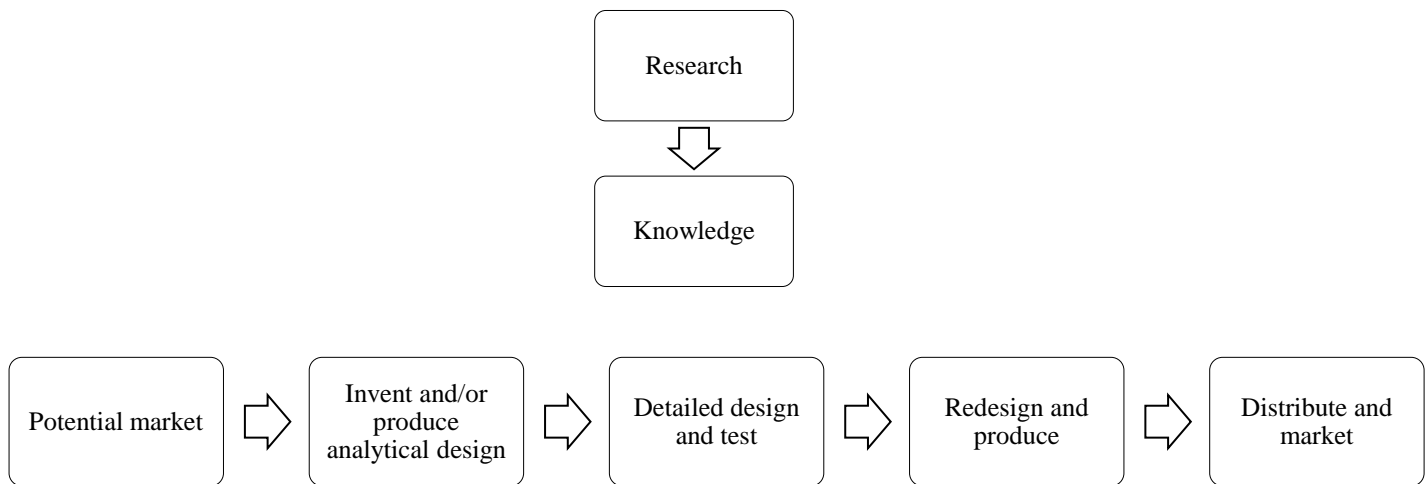


Figure 2. “Chain-link” model

It is important to remark that the result of research according to the model is not “innovation”, but “knowledge”, with which this innovation after is obtained. In order to become innovations for all in all meaning of the word novelties or improvements should be implemented in company’s operational activities. As a consequence, the firm achieves those objectives it set before and examples of which were shown. However, all of them can be united under one term that relates to Schumpeterian idea and Porter’s theory and which is called “competitive advantage” (Porter 2008). Virtually, if the innovation is new not only to the company, but to the whole industry, it becomes the source of advantage over other players on the market. Finally, with such an advantage, company starts to outperform its rivalries, which is directly changes its performance indicators and primarily financial ones. Indeed, the company that found a way to manufacture its product cheaper than competitors is able to set lower price for users and thus attract additional customers who will bring more cash flows to company and increase its revenues.

This way, the whole framework looks the following way:

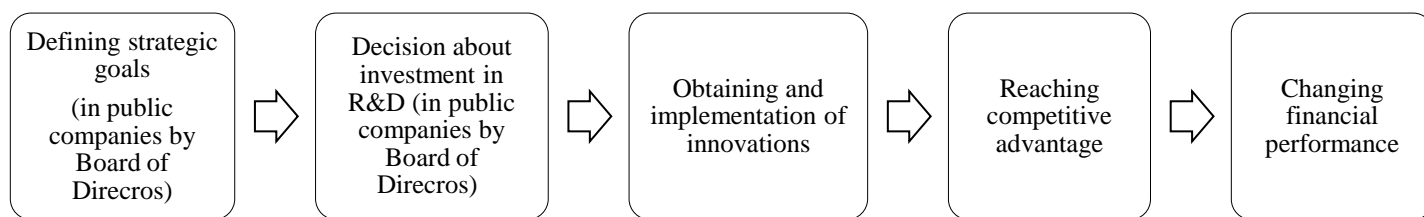


Figure 3. Innovation activities

Apparently, the reasons for low level of innovation activities among Russian companies as well as specific set of innovatively active companies in terms of industries is related to some stages of this process.

Practitioners have conflicting standpoints on the account. This way, HBR identified 5 key problems of innovation activities in Russian companies. The first one is related to absence of necessary experience and skills to organize innovation process, whereas the second one is connected to short tenure of top-managers who occupy their posts for 1 or 2 years, while R&D investments are long-term and demand consistent supervision and support. The problem number three deals with inequality of management teams in terms of innovative thinking, which is made worse by disciplinary HR management that kills creativity, which is following problem. The last but not least issue raised by HBR concerns the quality of top-managers presentation skills that plays crucial role in innovative ideas defense, since they are very risky (HBR Russia 2018). This way, unexpectedly, the majority of problems with innovations in Russia turned out to lie within management according to HBR. However, it is not the only one that sees the problem this way. In RBC they notice that the change in technology happens not when inventions are designed, but when new management models are created to successfully implement the novelties (RBC 2018). Another point of view is expressed by McKinsey experts who think that R&D investments are not the only one, but definitely the key element in achieving innovations. Moreover, they pay attention to the fact there is no clear evidence that innovations influence in positive way economic progress of the country (McKinsey 2018). This point may indicate that there is no such evidence not only on macroeconomic level, but on microeconomic level as well. So, since Russian companies do not experience significant impact of innovation on their performance indicators they underinvest in R&D because of that. This way, it becomes clear that the main doubts at least for innovative companies in Russia are attributed to two connections from the strategic logic of innovations developed before. The first one has to do with link between board of directors and R&D investment in terms of their intensity and amount of money allocated by the board for that purpose, while the second one casts shadow on a relationship between

innovations and firm performance, meaning that its direction (supposedly positive) is not so evident.

Thus, innovations have different influence on macroeconomic and microeconomic levels. In case of the former they play crucial role in knowledge-based economy, generating knowledge, while speaking about the latter, innovations influence firm financial performance helping company to achieve competitive advantage. However, making impact on the world economy as whole and on firm in particular, innovations are dependent on external environment and company's resources respectively. That is why different countries have different innovative landscape in terms of industry distribution. At the same time within one country, there are similar factors that define company innovative status by influencing same stages of innovative activities. In Russia, for instance they are connected to board of directors deciding on R&D expenses and their intensity as well as to the direction of financial performance change as a result of implementing innovations.

1.3. Innovations and company's performance

Having identified previously that there is no clear evidence for countries' economies that innovation lead to economic growth, we proposed an idea that it might be the same situation for companies as well, when they do not reach substantial improvement in their financial performance due to competitive advantage obtained through innovations. To find this evidence is indeed very hard because of innovation activities complexity and variety, which results in existence of numerous indicators measuring them, as it was shown before. That is why in many studies researchers simplify innovations till the level or intensity of R&D investments and/or number of patents, company has as the most important, easily obtainable quantitative proxy. Having seen that innovation activities might not include R&D, while patents do not indicate that firm is involved in innovation activities now, we still have to examine the findings of researchers who investigated the relationship between innovative activities and firm performance.

This way, many studies provide evidence in favor of positive character of this relationship (e.g. Doukas and Switzer 1992, Chauvin and Hirschey 1993, Szweczyk et al. 1996, Bae and Noh 2001, Bae et al. 2008). At the same time other studies proved this relationship to be negative. (e.g. Mank and Nystrom 2001, Lin and Chen 2005). However, a number of recent papers, which might indicate an evolution or at least development trend in terms of defining the character of this relationship, argue it to be nonlinear. They substantiate it with the help of different concepts.(Pantagakis et al. 2014) state that despite providing competitive advantage like every other type of investments R&D investments are characterized by diminishing return. So brining more benefits for company in the beginning, further they lose an ability to positively

contribute to firm performance and only accumulate expenses becoming waste of funds. In this paper hypothesis of nonlinear relationship was tested on a sample of 39 European hi-tech companies, so it was found that the optimal proportion R&D investments in sales is 41%. In other words when the level of R&D expenses reaches 41% of company's sales, the increase in firm performance, which was measured by return on assets (ROA) was supreme.

Another idea proposed in (Beld 2014) explains nonlinear relationship by competitors' ability to copy innovations. It definitely should be taken into consideration that other companies invest in R&D as well and may acquire similar innovations, which will help them, for example, to reduce costs more significantly and this way eliminate competitive advantage. Generally the idea is that innovations do not belong to one company for a long time, especially when they are not protected with patents or licenses. Another interesting point of this research is that the author proposed an idea that there is a difference in terms of the relationship between R&D investment intensity and firm performance between service and manufacturing companies, since for the latter ones, there are a lot of opportunities to innovate in production process. However, this hypothesis did not find practical justification. Finally, it is important to notice that in this case an optimal portion of R&D investments in comparison with sales reached only 12%, which might be attributed to several reasons. The first one is connected to industry distribution of companies in sample, which consisted of hi-tech companies in the previous research to compare with 230 service and 158 manufacturing companies in this one. Moreover, current study concentrated on companies from Belgium, Netherlands and Luxemburg (BeNiLux), while the sample of research above included companies from all over Europe.

One more point, substantiating the nonlinear relationship was introduced by (Zhu and Huang 2012). They make emphasis on resources' limitation of every company. According to this idea, even if a company was successful in obtaining a lot of innovations as a result of R&D investments it can not implement all of them because of lack of resources, which are needed for it. Thus, in spite of company investing in R&D its results are not put into practice, company loses money, decreasing its financial performance. Moreover, the authors of the research distinguish a set of reasons aiming at explaining the reasons for studies of relationship between R&D investment intensity and firm performance being unsuccessful. The first one is the absence of lag between investments and change in financial performance indicator, since the investment especially long-term as R&D need time to give an effect. Secondly, it is necessary to control for industry, because R&D investments have their way of effecting and peculiarities of implementation. Thirdly, the legislation of different countries greatly varies in terms of disclosure of information about R&D expenses. In many of them, for example, China, companies

were not obliged to make it publicly available and publicized only successfully finalized investments to managers advantage in front of investors, owners and society. In addition, the authors remark that certain innovations may even make the company possessing them a monopolist. As for the practical side of those hypotheses confirmation, the researchers taking into account the pitfalls other authors did used a sample of 106 Chinese companies operating in IT.

Another set of justifications for R&D inverted U-shape relationship with firm performance was proposed by (Yang 2010). First of all, he substantiates this idea by claiming that R&D investments are subject to economies of scale, when company's costs start decreasing, upon reaching certain scale of production volume. Generally it might be connected to reduced price due to wholesale procurements, cheaper loans because of huge sums of money, company asks from bank, less expensive marketing campaigns, when one campaign may use the same campaign in order to promote several products. Speaking of this particular case, it means companies that will be capable of spreading their fixed costs associated with facilities and R&D equipment over a decent number of R&D projects will reduce the average costs of R&D project. This way, such firms will acquire an advantage in costs in comparison with their competitors. However, if to increase the number of projects exploiting cost reduction trend after a certain point another type of costs will start to increase and outweigh the economy from fixed costs. The reason is that bigger number of R&D projects demands significantly more efforts in terms of management and coordination. Thus, gradually this trend will result in diseconomy of scale worsening firm's performance.

Secondly, the author proposes the idea similar to the one that has been described above and concerning diminishing return. He poses that a firm involved in innovation activities starting its first R&D projects does not know how to execute it, which leads to significant costs and modest results. However, with every single project that follows the firm gains experience and develops knowledge and skills of execution, which eventually boosts productivity. Nevertheless, after a certain point indicating the number of R&D projects productivity can not be increased more and it starts to fall leading to decrease in firm performance as well.

The supposition number three is closely connected to the idea of time lags and projects combination. The researchers point out that overall R&D projects' marginal utility becomes dynamic because of their long-term character. In other words it might happen that different R&D projects occur at different stages of completion. For example, one of them is already implemented and results in increased operational efficiency, while the other one is just started. At the beginning the first one positively impacts firm performance outweighing costs the

company carries for the second one, but gradually the effect of the first project starts to run out while the expenses for the second steadily increase at particular point starting to prevail. This way overall relationship between innovations and firm performance becomes an inverted U-shape.

Finally, coming back to experience and learning curve the company goes through, while executing R&D projects the author remarks that necessary skills and knowledge obtained in the process are limited to certain extent. It means that R&D projects have some similar steps and stages, but they hardly prevail the difference between each one of them. This way, if company shifts from R&D project in one field to R&D project from a completely different realm, there will be only few similarities, and skills and knowledge gained through previous experience may become not relevant. Thus, the inverted U-shape of the relationship between innovations and firm performance will be even steeper. Taking into account all these assumptions the author formulated hypothesis of nonlinear (inverted U-shape) character of the relationship in question, which proved on a set of real data consisting of 100 Chinese electronic manufacturing firms.

As we can see, all the papers analyzed above confirmed or rejected their hypotheses on a sample of companies from Europa or China, but it might be that in the context of Russian economy the picture will be different. However, a few researches have been dedicated to identifying the relationship between R&D investment intensity and firm performance in Russia. In one of the recent papers, which can be attributed to the topic (Shakina E. et al. 2017) the authors do not explicitly state that they investigate this relationship identifying the link between company' intangible assets and competitiveness. However, if to look at practical side of the research, one of the main components in intangible assets they use is R&D investments. Moreover, competitiveness of firms is measured by Economic Value Added indicator (EVA), which might be also used for measuring firm performance (N.Shil 2010; S. Hundal et al. 2015; T. Prusty 2013). In addition, under our framework, which assumes that change in firm performance derives from competitive advantage, change in competitiveness in this paper means almost the same. This way, the study becomes quite relevant to our research. However, its results do not suggest any kind of relationship between R&D investments and firm performance, confirming, though, that the difference between competitiveness of European and Russian companies is attributed to various levels of intangible assets among those two groups, including different R&D investment intensity. Furthermore, this paper touches a remarkable point of the companies' differentiation in terms of their legal entity's incorporation. The researchers indicate that the companies they used to check if their hypotheses are right or wrong were public. Indeed

in previous papers the authors did not make emphasis or even indicate, if the companies they use for sample were public or private. We may assume there are several reasons for that.

First of all, it might be connected to the fact that their sample consisted of both public and private firms. This way, there was no point in mentioning that firms of two groups are included. Secondly, it is possible that the authors did not consider the form of companies' legal entity's incorporation be connected to relationship between R&D investments and firm performance. The reason number three is that it was assumed by default that one of those types of companies was used.

Whatever reasons were actual, it is worth noticing when at least it comes to Russian companies, which are of our primary interest, it is important to take into consideration the fact, if the companies under investigation are public or private. The most obvious of them is connected to information accessibility. In comparison with publicly owned companies the private ones are not obliged to disclose their financial results, strategy prospective, information about management and etc. This way, if to investigate private companies, there might be no sufficient piece of information to test hypotheses in question. Secondly, it is not an open secret that transparency of company's operations attracts more resources, including financial ones. This way, generally when companies are in need of huge sum of money striving for high results based on stable business model, positive macroeconomic and industry trends they go public. Last but not least, is that accumulating significant resources of all kinds and operating on a large scale public companies are obliged to use respective management mechanisms in order to successfully reach strategic goals. One of the most important conditions under which public companies in Russia can operate is that they are obliged to organize board of directors responsible for strategic perspective of firm's development including investments in R&D and innovation activities as whole. This way, it is logical to continue discussion about the relationship between board of directors and investments in R&D, which we will do in the next chapter, but now there is one important comment left.

It is interesting to notice that different researchers used various indicators to measure company performance. This diversity can truly be compared to the ways to measure innovation activities, and in this case as well there are some indicators that are used more frequently. First of all, a lot of researchers (M. Bouras and M. Gallali 2017, I. Berezinets et al. 2013, E. Al-Matari et al. 2014) use Tobin' Q to measure company's performance, a line of papers (N.Shil 2010, S. Hundal et al. 2015, T. Prusty 2013), as we have already seen previously, utilize EVA for that matter. However, the recent studies (E. Pantagakis et al. 2014, Z. Zhu and F. Huang 2012, B.

Beld 2014, Nishi T. 2015 and etc.) adapt an approach of exploiting ROA in order to measure firm performance.

ROA (stands for return on assets) is the ratio, which is calculated as a relation of EBIT (earnings before interest and taxes) to total assets. One of advantages this ratio has is that it measures company's ability to efficiently use assets it has, since it shows how much money is generated per unit of assets, which no other indicator reflects. Moreover, because ROA is an accountant indicator, it is not influenced by market fluctuations of share price, which might not be related to company's actual performance. Thirdly, in comparison with EVA and Tobin's Q this indicator is much easier to calculate, and it is more frequently used by practitioners, which makes it highly operational. In addition, measuring efficiency of company's assets ROA is directly related to R&D, which improve company's processes or products. Finally, in order to apply high value of this indicator, managers of big corporation (which usually have a lot of assets on their Balance Sheet) have to do their best to make assets "work" efficiently to generate enough profits. Thus, ROA helps to measure management efficiency as well (Volkov 2004).

That is why in this paper following the pattern of recent trend (E. Pantagakakis et al. 2014, Z. Zhu and F. Huang 2012, B. Beld 2014, Nishi T. 2015 and etc.) we rely on ROA as well.

Taking all of this into account, the first hypothesis of this research is formulated as follows:

Hypothesis 1: There is nonlinear relationship between R&D investments intensity and firm performance of innovative companies

First chapter conclusions

Drawing the line under the discussion above, we should conclude that term innovation is very complex and subjective, which every author defines according to the purpose of the research. This peculiarity is explained by the complexity of innovation activities themselves. Frequently they are mistakenly narrowed down to R&D, though it might not even be the part of innovation process in some cases. Similar delusion is that a firm without patents and licenses is not innovative. At the same time, the amount of R&D investments and number of patents are the most habitually used indicators to measure innovative activities, to which we have to stick because they are more easily obtainable and more objective in comparison with other indexes. The main reason why companies become innovative is that through innovations they earn competitive advantage, which they utilize to increase their performance. However, the relationship between R&D investments that serve as proxy for innovations and firm performance is considered to be inverted U-shape by recent line of papers on the topic. In Russia, where companies reluctantly invest in R&D, there were few studies dedicated to investigation of this

relationship. Simultaneously many practitioners connect the phenomenon of underinvestment in R&D with its unclear relation to firm performance as well as the problems associated with bodies inside the company, which make decisions about investments in R&D.

2. BOARD OF DIRECTORS' INTELLECTUAL CAPITAL

2.1. Board of directors as a major internal corporate governance mechanism

Board of directors is a key element of corporate governance. That is why, firstly, it is needed to define this term. There no unified definition of “corporate governance” has been developed yet, so different organizations and institutions interpret it in their own way. This way, International financial corporation (IFC) under corporate governance understands “structures and processes of companies’ management and their control” (Corporate governance. Overview 2018). Capital markets service of The Russian Bank cites four definitions of corporate governance. Ranking them “from general to more specific” A.V. Bukhvalov and M.V. Smirnov get the following system:

- 1) Corporate governance is a system of relationships between managers of the company and its shareholders aimed at solving issues regarding efficient performance provision, protection of interests of shareholders and other stakeholders.
- 2) Corporate governance is a way of ruling the company, which provides fair and equal distribution of performance results between all shareholders and other interested parties.
- 3) Corporate governance is a set of rules that help its shareholders to control management and influence it with a purpose to maximize firm value.
- 4) Corporate governance is a system of reporting to shareholders of those who are trusted to manage the company (Corporate governance: history and practice 2018).

However, more adequate and full definition according to the researchers defines corporate governance as “a system of economic and legal relationships and standards, with a frame of which corporate control, rights and cash flows are distributed between shareholders, managers and different other stakeholders” (Bukhvalov A., Smirnov M. 2012).

One of the topical issues regarding corporate governances is a problem of relations between shareholders and managers or so-called “agency problem” that was for the first time formulated by (Jensen M. and Meckling W. 1976). It is directly related to separation of ownership from ruling, when the owner leaving to himself or herself only control over the most important decisions, delegates management of operational activities and formulation of suggestions about strategy to a hired manager for remuneration. However, interests of hired manager and company’s owner aimed at maximization of personal gain differ from each other. The former is interested in high salary, different bonuses, perks and benefits; while for the latter firm’s capitalization increase in long-term perspective is important. Moreover, shareholder may

diversify his or her risks, making investments in other companies, whereas manager does not have such an option. However, manager's better knowledge of state of affairs inside the company in addition to absence of opportunity to directly control for agent's action for shareholder because of high costs open up a loophole for manager to behave opportunistically. This way, the difference between performance functions for manager and shareholder rise a problem "principal – agent", which is solved through different internal and external mechanism of corporate governance. One of these mechanisms is embodied in board of directors' activities.

Throughout the whole period of corporate governance development, its importance only increased. It became especially demanded now, which is directly connected to the increase in capital share of institutional and portfolio investors. This type of investors as a rule are minority ones, who buy small stakes (up to 10%) in many companies and are unable to actively take part in managing corporations and that is why have to pass their regulatory rights to the company's management. At the same time they pay close attention to invested money spending, which should be organized by managers effectively and efficiently. This way, the importance of board of directors as an intermediary between managers and shareholders as well as the quality of corporate governance in such ownership structure increases. The absence of portfolio and institutional investors restrict company's growth and, thus, negatively affect on return for other types of investors (Gazin 2003).

Speaking about necessity for emergence of corporate governance mechanisms in our country, it is worth noticing that since the end of 1990s this term has become topical in Russia. The reason for that is a shift in country's economy from command-and-control model to the market one with corresponding privatization of many companies. Firms turned out to be in private property needed to develop their own mechanisms, which would allow them to stay competitive and satisfy owners' expectations. This way, they took as example European and the USA approach to forming corporate governance, which included three elements of corporate governance: shareholders, board of directors and management, though adapting the framework to local peculiarities. (Corporate governance guidebook 2004)

One of the main distinguishing features of Russian corporate governance is high ownership concentration. According to the latest research of Deloitte, it is observed that in more than 60% of Russian companies there is one major shareholder, to which more than 50% of the capital belong (Deloitte 2015). Simultaneously the requirements for listing on Moscow stock exchange in first and second echelons demand that only 10% of shares are in free circulation (Listing rules 2018). With a view of such state of affairs the problem of relationship between shareholders with major stake and those with minor ones come to the boil, since it is often

happens that all key decisions are taken by the majoritarian owner. Minority's rights, this way, sometimes are violated, while interests are not taken into consideration at all. This way, board of directors in a system of corporate governance becomes a third party, which serves for guarantying respect for minority's rights and interests. But what is exactly board of directors and which functions does it accomplish?

Board of directors is a collegial body of joint-stock company's governance, which reports to annual shareholders meeting and which consists of equal members taking decisions through voting on absentee and on-site meetings and carrying responsibility for the results of a trusted joint-stock company. Members of the board are elected by annual shareholders meeting for a particular period of time for managing joint-stock company within the borders of the rights defined by law and statute of the joint stock company (Filatov 2014). In a joint-stock company with number of shareholders less than 50, the statute can prescribe that its duties will be accomplished by the annual shareholders meeting. So what are these duties exactly?

According to the Law about joint-stock companies, "board of directors is responsible for the general management of the company, excluding issues assigned to the annual shareholders meeting" (Federal Law from 26.05.1995 N 208-FL 2018). The list of board's competencies consists of 18 points, some of which include sub-points, which one more time highlights the scale of authority rested upon this body. In addition, it indicates that it is very hard to unambiguously define the borders of board's rights, because of complexity of its activities. Moreover, the law defines board of directors' span of control not to the fullest, leaving the room for flexibility upon company's needs.

The code of corporate governance in Russia distinguishes 7 sub-points of board's activities explaining the gist of 3 main aspects: strategic management, risk management and control for executive managements bodies. Expanding on the content of these directions let us notice that competences of board of directors include:

- 1) evaluation and approval of company's strategy, business plan, confirmation and control for key performance indicators;
- 2) appointment and dismissal of people occupying posts in executive bodies of company;
- 3) development of main approaches to risk evaluation and management, execution of internal and external audit control;
- 4) provision of informational transparency, including election of board members;
- 5) development and confirmation of a policy for executive board and board of directors motivation and remuneration;

- 6) control of respect for rights and interests of all company's stakeholders, including prevention and mitigation corporate conflicts;
- 7) monitoring practices of corporate governance and its evaluation for the purpose of meeting company's goals (Corporate governance code 2014).

Moreover, crucial role in a described system of corporate governance is played by board of directors, since this body in accordance with Russian legislation is given a set of exclusive rights:

- 1) the right to form an agenda of annual shareholders meeting, which is managed by board chairman.
- 2) the right to suggest solution regarding the most important decisions as dividend policy that no other corporate body;
- 3) the right to take the rights of annual shareholders meeting and executive committee, including the ones connected to their formation and ceasing existence.(Korolev 2011)

This way, in Russian companies the duties of board of directors according to regulatory documents have a strategic character and are concentrated on:

- 1) policy of strategic business development;
- 2) financial policy;
- 3) dividend policy;
- 4) risk management approach;
- 5) top-management motivation and performance evaluation;
- 6) major deals control.

However, board of directors can be viewed not only from standpoint of legal rights and duties it accomplishes. In addition to juridical dimension, in which board of directors was described above and to agency theory, which is rooted in the agency problem, also explained before, there is one more theory, which enormously contributes to the overall significance of this corporate governance mechanism. Board of directors is also viewed from the resource dependency (resource-based) theory. According to it, the whole organization is considered as a set of resources (tangible and intangible) and capabilities. The theory in question states that all organizations are dependent on their set of resources and capabilities. Those of them, which are valuable, rare, hard to imitate and substitute become the basis for sustainable competitive advantage, which we discussed above. In this context board of directors can be seen as resource, which if meets the criteria above may also provide a firm with competitive advantage. To be more precise, board members' aggregated knowledge, education, experience and competences are regarded as intangible resource, which contribute to company's operations and performance

(Pfeffer and Salancik, 1978). In addition to this, through their wide network of contacts board members may not only provide a firm with their own resources, but give an access to external knowledge, experience and etc. of other people as well. The third important point is that directors with their status and reputation in society and business world are able to enhance reputation of a company, which they represent, this way also making contribution to its performance in indirect way. Finally, board of directors may not only use its intangible resources to make decisions regarding the activities we described previously, but also to give an advice to executive committee or other management bodies of a company. At the same time the intangible resources, which directors possess and which were listed above are usually united under the term “intellectual capital”, on which were expand further (Maasen 1999).

This way, it should be said that board of directors being one of the key mechanisms of corporate governance can be viewed in legal context according to which it concentrates on company's strategy development, risk management, executive assignments, dismissals, remuneration and motivation; major deals control, financial and dividend policies. From standpoint of agency theory it serves as an intermediary between shareholders and managers. According to resource-based view, board of directors provides company with intangible resources of its members, on which we will focus further.

2.2. Main elements of board's intellectual capital

The concept of intellectual capital started actively developing since the beginning of 2000s. In one of the early works intellectual capital was defined as the knowledge a company has that can be used to create a competitive advantage. Later the definition was enlarged to embrace not only knowledge, but rather all intangible assets: intellectual capital is an intangible source of value (promise of future gain), borne by innovations (inventions, discoveries), unique organizational projects, or HR management practice. The classic definition of intellectual capital, however, was given by (Roos et al. 2005), according to whom intellectual capital is “all non-monetary and intangible resources, which are fully or partly controlled by the organization and participate in value creation”. On the other hand, as the authors highlight, in the process of value creation, intellectual capital participates mutually with other capital sources. In this case intellectual capital management is a usage and management of intellectual resources and their transformation (either one group of intellectual resources into others or into other economic resources) in order to maximize firm's present value in favor of stakeholders. Also it is important to remark that tangibility and intangibility of resource relates to its identification, while difference between traditional (material and monetary resources) and intellectual ones (organizational, human, social) deals with the form of economic functioning. Moreover, there is

one important point that can not be underestimated in the process of evaluation of approaches to the definition of intellectual capital. That is connection between intellectual capital and company strategy. Since nowadays intellectual resources count for the main part of company's resources, competitive advantages by resources is achieved mainly on advantage by intellectual capital. That is why as authors conclude intangible assets become the main strategic assets of the company.

Traditionally intellectual capital is viewed to consist of three elements:

- 1) Human capital implies all the knowledge, experience and skills that employee possesses and gains during the working in company, which he or she will take away with him or her leaving the company. Some of these elements might be individual, which the only person has, but others are general ones, which are shared by several employees;
- 2) Relational or social capital is logically about resources connected to external relationships with stakeholders (suppliers, customers, investors, creditors). Moreover, it includes the perception of the company those interested parties form.
- 3) Structural or organizational capital is classified as knowledge that stays within the firm, even after employees who created it left the company. It covers such topics as organizational routine, systems, procedures, databases and cultures. Some of these elements might be protected by intellectual property rights and become legally owned by company (Seemann 2000).

The particular examples of each of company's intellectual capital elements are cited below in the table:

Table 1

Elements of company's intellectual capital (Rahman M. M. and Khatun N. 2016)

Human Capital	Relational (social) capital	Structural (organizational) capital
Know-how	Customer loyalty	Patents
Education	Customer satisfaction	Trademarks
Work-related knowledge	Links with suppliers	Design rights
Work-related competences	Negotiation capacity with financial entities	Corporate culture
Teamwork capacity	Business collaborations	Information systems
Employee flexibility	Licensing agreements	Organizational routine
Learning capacity	Brands	Management processes
Motivation and etc.		Management philosophy

As can be seen, company's intellectual capital includes a lot of items, which penetrate all company's activities. However, the division of intellectual capital into human capital, relational capital and structural capital is not the only one, though the most topical. Another approach is to consider intellectual capital for the main corporate bodies separately. This way, intellectual capital of the company can be viewed as a sum of intellectual capital of board of directors and intellectual capital of other organizational units. In the literature a lot of attention has been paid to intellectual capital of the whole company, and very little to the intellectual capital of company's board of directors.

One of the first definitions of board's intellectual capital was given in (Stewart 1997), where it is defined as "the intellectual resources such as knowledge, information, experience, relationships, routines and procedures that a board can employ to create value". Further the concept was developed by (Dalziel and Hillman 2003). The authors linked resource dependence theory with intellectual capital of board of directors and identified it as the antecedent of the provision of resources. Moreover, in this work the term "board capital" was introduced as a sum of board's human capital and relational capital that before had been discussed in scientific literature separately.

This way, board's capital consists of human capital and social capital and does not include organizational capital, since directors are not directly involved in constructing information systems or design rights. They may participate in finding the people, who will complete these tasks or they may take strategic decisions, allowing companies to obtain more patents or trademarks, but it can be regarded only as indirect connection. As for other two elements, examples of their components are cited on the scheme below:

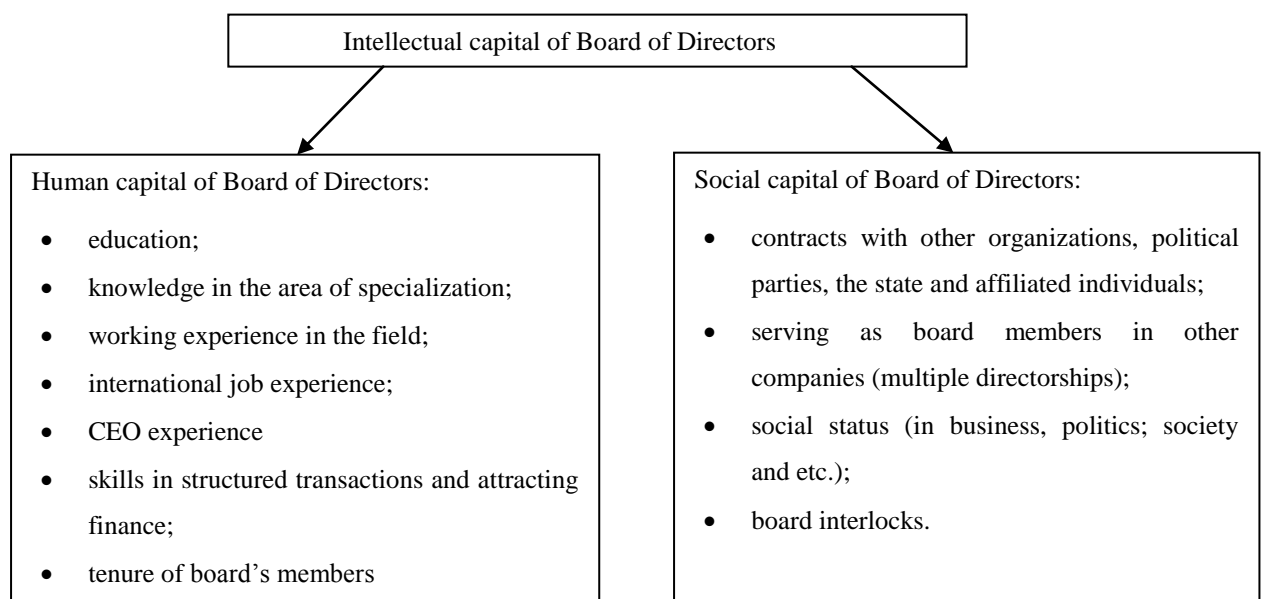


Figure 4. Board of directors' intellectual capital structure

If to speak about human capital, one of its key components is education. Basically, it provides directors with a store of knowledge and skills in particular sphere (from management realm to the field of construction, for example), which serve as a ground for making decisions. It is worth noticing that in many cases it is highly valuable if director has an educational background connected to the sphere, in which the company operates. In this case this it is highly likely that such director will be able to more deeply understand industry dynamic and learn about specificity of company's business model, which will influence final decisions. Also it is valuable for company, if director has management education since this body deals with corporate governance, which requires understanding of basic managerial processes. Finally, it might become beneficial for company, if director had a major in different management concentration like finance (especially, accounting and audit), marketing, logistics, human resources and etc., which in this or that form present in each company (Sulinska 2018).

However, often people develop expertise and evolve competences by getting experience. For example, graduating from philology and not having specific education in oil and gas I.I. Sechin successfully carries his duties on the board of Rosneft, one of the biggest Russian oil company's partly based on his enormous experience in the industry, in which he has been working for more than 10 years (Annual report of PJSC NC Rosneft' for 2016, 2018). In addition to working experience in the industry of company's operation, which gives an idea of the mechanisms, according to which it works, an international job experience might be also of help. It can be viewed as an experience of working abroad, which will provide director with country-specific knowledge of business ethics, economic potential and etc. as well as an experience of working in a multinational corporation, which usually have their own peculiarities. Through experience people train to complete certain operation, and for the board one of the most important and difficult one is accomplishing major deals, especially mergers and acquisitions. Those directors, who participated in them previously, will be able to prevent the board from some mistakes and contribute to the whole organization of the procedure. Finally, it might be a huge asset for company's if a member of its board occupied or occupies CEO position in other company's since in that case he is likely to be skilful in running business, which increases and enlarges his or her managerial competences greatly, since CEO is responsible for the whole company's operating activities.(Booth-Bell 2018)

One more integral component of board's human capital is tenure, which concerns the knowledge about particular company. It is an open secret that companies operating in the same industry may have totally different business models. Moreover, as it has been said before, each company has its unique set of resources and competences including corporate culture. This way,

being aware of company's internal environment, directors may act more wisely and take into account firm's strong sides and weak points.

What concerns board's social capital, one of the key terms there is multiple directorships, which refers to phenomenon, when director sits on board of more than one company. Such directors are usually called "busy". Multiple directorships will be investigated in detail further, but now it should be said that having access to several board rooms directors are exposed to many informational flows, have an opportunity to establish beneficial contacts, which they might exploit in favour of the company. (Stevenson 2009)

Board interlock is a term closely connected to multiple directorships; however, it describes a situation, when director or executive of one firm is also a director of the other firm, whose board's member in his turn sits on the board of the first company. This way, both directors sit on both boards and connect companies. In accordance with resource-based view again it multiplies directors' opportunities for establishing useful contacts, learning helpful information and wide spreading successful practices and business approaches.

At the same time, not only networks with members of other board might be beneficial for director and the firm. External contacts with state officials and different politicians may become a bridge to government support in form of subsidies or tax concessions. It is especially important for Russian companies, in which as a heritage from Soviet times, it is typical situation when state is a majoritarian shareholder with controlling stake. In this case government's approval of company's policy defined by board becomes crucially important, and personal contacts of board members with state officials are a key to success (Tejedo-Romero et al. 2017).

It goes without saying that director's status in business, politics and society, as it has been said before is normally transferred to company's reputation, since director serves at its representative. Improving company's image or worsening it director influences company greatly. Also status is another way to establish new contacts, in which company's reputation and director's status affect each other interdependently.

Generally speaking when a director earns experience working abroad or gets education, he or she meets new people and starts relationships, which might be beneficial for his private live and professional career at the same time impacting the company, on the board of which he or she sits. It highlights interdependency of human capital and social capital, proving the right approach of (Dalziel and Hillman 2003), united them under "board capital" term.

The next important step in board's intellectual capital theory development concerned the dynamic approach to this term. In one of the latest papers on the topic (Berezinets et al. 2016) the authors, defining board's intellectual capital as "the ability of the company to extract future

economic benefits from intangible resources possessed by member of the board”, instead of just “set of resources”, which corresponds with company’s intellectual capital definition given by (Roos et al. 2005). They notice that board’ intellectual capital should not be considered a static resource, since during director’s tenure he or she develops new skills, competences, gains knowledge and etc. Secondly, because of rapid changes in industry and macro-environment different director’s knowledge may become relevant at different periods of time. For example, developing new strategy company decides expanding on new geographical market, and simultaneously director’s experience of going abroad, which previously was irrelevant, becomes highly wanted. Thirdly, the board composition itself is dynamic. In other words from year to year different people become board’s members, consequently changing the composition of board’s intellectual capital. Finally, human and social capital invested in developing companies activities does not pay off immediately, which is why it is not logical to monitor changes in firm performance the same year , when the particular board was elected.

Besides the conceptual step forward in terms of developing board’s intellectual capital term, the paper in question is highly valuable due to its systematization of the existing researches of board of directors’ structure and composition and their relationships with firm performance indicators. The paper, however, does not simply mention the line of similar researches and describe their findings, it strives to grasp the variety of different aspects of board members’ characteristics and explain these or that results of researches. For example, analyzing human capital of board of directors, the authors not only consider obvious benefits of general experience of directors, but stress their attention on experience in particular spheres, such as political experience. Moreover, the authors take into account potential negative aspects of board’s capital components. For instance, such parameter as board tenure can serve as a proxy variable of experience and be positively and negatively related to quality of director’s decision making process. On the one hand, better knowledge of the company helps to more precisely identify its capabilities, but on the other hand, it creates the kind of a stereotype that prevents director’ from thinking the other way and changing the company. Moreover, the authors remark that inviting CEOs of other companies on board may positively contribute to firm intellectual capital not only because such directors are believed to be more competent in current economic and business environment, but also since they give a signal to market agreeing to become member of board of directors of a promising future and high corporate governance standards of the company.

In addition, the paper provides the reader with an overview of the results of the latest surveys in corporate governance field in Russia, the situation in which is different due to peculiarities of economic development discussed above. This way, according to PricewaterhouseCoopers survey, today in Russia many companies suffer from their directors’

lack of strategically important skills: experience in the industry, experience in risk-management and financial expertise. In this aspect the finding that since the financial crisis of 2014 the number of directors with financial expertise and experience in public companies has significantly increased can be perceived as a way to provide company with more thoroughly developed economic and financial policy.

2.3. Relationship between board's intellectual capital and innovations

As it has been discussed above board of directors make strategic decisions, including the ones about innovation policy. The basis for such decisions lies within board capital, however, it is not clear which components and how are connected to innovations. One of the researches striving to investigate it (Bravo et al. 2017) considers relationship between 2 particular elements of board's intellectual capital (board tenure and multiple directorships) and R&D investment intensity.

In spite of main empirical findings of the article, first of all, it should be distinguished the profound theoretical analysis, the authors provided. They did not try to fully cover intellectual capital of board and even social or human capital, but rather concentrated on particular parameters of both elements in order to deeply investigate them. As for board tenure, they consider it from the perspective of 2 theories: resource dependence one and agency theory. This is also a novelty of this article, since the previous researches mainly took into consideration only one side of the coin completely forgetting about the other. This way, from resource dependence theory directors accumulate valuable knowledge and skills about company, sphere of business, in which it operates, and so it that can enormously contribute to speeding decision making process and particularly adopting R&D investment strategies, since such directors are more aware of industry's dynamics and emerging opportunities. From the perspective of agency theory, however, directors with longer tenure lose a capability of efficiently controlling and facilitating strategy implementation process. They become accustomed to companies routine and lack performing monitoring function that is especially important for R&D strategies regularly associated with the high level of risk. As a result of a combined, but oppositely directed effects, the authors logically assumed the relationship between board tenure and R&D investment intensity to be nonlinear that eventually is proven by the results of regression analysis.

Completely the same approach was used by the authors in order to investigate multiple directorships that will be discussed in detail later. So far it should be noticed that the hypothesis of nonlinear relationship between the number of directorships and R&D investment intensity was proven by results of the research.

As for the sample, the authors used to investigate developed hypothesis, it should be noticed that it consisted from 1 716 firm-year observations. All the companies included in the sample were traded in New York Stock Exchange during the period 2007 – 2011. In addition to the variables, responsible for testing hypotheses leverage and company size were also included into the model. In addition, board age, CEO duality and ROE traditionally were considered to have an effect on R&D investment intensity. Besides it is interesting that the authors in contrast with previous researches, included industry variable, dividing companies into low-tech and high-tech, but assumed it be not significant, since they think that the main function of board of directors, strategy development is equally important for each company like the necessity to innovate. Moreover, it should be remarked that the authors also added crisis variable that took the value of 1 if there is a negative GDP annual growth rate and 0 otherwise.

The results of this study significantly vary from results obtained in other papers, which explored board tenure effect on R&D investments decisions, mainly because other researchers focused their attention on board' capital either in agency theory or resource dependence view. This way, on the one hand, those directors who have recently joined the company do not possess enough information about firm's resources and opportunities in comparison with members that sit on board longer. That is why new directors will probably be less inclined to heavily invest in risky R&D (Ruigrok et al. 2006, Jackling and Johl 2009). On the other hand, those directors that know company for a long time may have some kind of a bias point of view on its strategy. This cognitive framework may prevent them from investing in R&D making to be conservative about company's course and ignore new R&D projects (Midavaine et al. 2016, Kor, 2006, Chen 2012).

In alignment with standpoint of (Bravo et al. 2017), we formulate the hypothesis of the research in the following way:

Hypothesis 2: There is a nonlinear relationship between board's tenure and R&D investment intensity

Among other important characteristics of the board that recently became very topical is multiple directorships, which is an element of board's social capital. As it has already been said, this term is closely connected to the term "busy directors", which relates to directors who perform their duties on boards of several companies. Again as it was with tenure, multiple directorships can be viewed from resource dependency view and agency theory.

According to the first one, presence of busy directors on the board signals high quality of corporate governance in the particular company, since it is implied that directors who have already serve as board members in some company can be attracted to another one by the level of corporate governance standards established there. Moreover, directors who are able to show

good abilities in monitoring and giving advice obtain additional appointments (Fama and Jensen 1983). They signal to the market that this particular director is efficient and valued by other companies. In other words, the fact that the competences of the director are demanded by several firms, gives the positive signal on the talents and experience of this director (Masulis and Mobbs 2014). In addition, it is connected to the point that board members should consult executive board on strategic issues, which demands vast experience, profound knowledge about the company itself, the industry it operates in, broad network and access to resources. (Kor and Sundaramurthy 2009). While serving for several boards, director has an opportunity to compare different activities, learn useful skills, get important information, participate in making strategic decisions, develop new approaches and enlarge experience, which is good both for the company and for the director (Coles and Hoi 2003, Fich and Shivadasani 2007, Bugeja et al. 2009). Thus, multiple directors might be better networked, helping the company to get access to valuable resources and establish more linkages with the external environment (Booth and Deli 1995).

Innovative firms need more advising than monitoring, because R&D are exploratory in nature and imply unpredictable obstacles and outcomes. During the innovation process, advising from the directors is truly required to solve the unknown problems and increase the chance of success. Busy directors with more business connections, experience and expertise are expected to provide better advising during the innovation process. Furthermore, stringent monitoring from board of directors may not be optimal for innovative firms. With intensive monitoring, managers are left with limited discretion and flexibility, which may have unfavorable effects on corporate innovation. (Gu and Zhang 2016). Managers with limited discretion may be discouraged to engage in innovation, because they feel they are lacking the freedom to adapt during the innovation process. Moreover, managers under intensive monitoring may be afraid to take on innovation projects due to their career concern. If the innovation fails, managers are more likely to be fired under effective board monitoring. Thus, innovative firms require more advising, but less monitoring in order to promote innovations, and busy directors are likely to provide firm with the resources necessary for successful investments in innovations and for the implementation of R&D investment strategy.

However, simultaneously, it can be easily understood that sitting on the board of several companies, busy directors have less time to thoroughly investigate its internal processes and dedicate enough energy to considering peculiarities of the industry and elaborating on strategic decisions, including R&D investments (Lei and Deng 2014, Lopez and Morros 2014). Problems with the time availability can be demonstrated through meetings attendance. In the study of (Jiraporn et al. 2009) the authors have discovered that busy directors as a result of the addition of excessive liabilities tend to miss meetings of the board of directors. According to agency theory

doubts, directors with many positions are not able to successfully perform their monitoring functions in each company, for such directors have to participate in many meetings and be immersed in the deals of each company, in which they seat on board. Consequently, they do not have a lot of time for a really thorough analysis of the strategies of each company. A large number of appointments can make directors overcommitted and consequently compromise their ability to monitor company management effectively (Fich and Shivdasani 2006, Lei and Deng 2014). Additional appointments will increase agency problems, because directors will perform an inadequate control of firm management as a consequence of the reduction of the time that each board member can devote to each firm. These limitations of busy directors should most clearly appear during major strategic decisions (Harris and Shimizu, 2004), and therefore, these directors can not promote R&D initiatives.

The combined effect makes presuppose a nonlinear relationship and assume that only till a particular number of directorships additional positions really contribute to director's resource value for the company. This way, in a line with (Bravo et al. 2017) we state the following hypothesis:

Hypothesis 3: There is nonlinear relationship between multiple directorships and R&D investment intensity

The third important component of board's intellectual capital, which is crucial for decisions about innovations, is education. Researchers investigated its relationship with R&D investment intensity from different perspectives. For example, some researchers found that board diversity in education positively affects innovative performance. In recent paper of (Midavaine et al. 2016) the authors using a sample of companies from high-tech industries obtained the similar results, having found positive relationship between diversity of board members education and R&D investment intensity. (He et al. 2010) go further in their research, concluding that "the higher that proportion of Ph.D. on board, the greater R&D expenditure". In one of the recent papers on the topic, (Midavaine et al. 2017) analyse the board diversity in high-tech companies in relation to innovativeness, and make conclusions that the educational diversity leads to more R&D investments.

The share of directors with educational background in the field, in which company operates, may be important when it concerns R&D investments (Dalziel 2011, Bravo et al. 2017). Directors with a special education probably will better and faster understand positive effects of innovations, will be able to explain perks and benefits of their development for the company. Furthermore, these directors may contribute to smart R&D strategy implementation through their network, knowledge and in general to shift board's attention during strategic issues

discussions towards the innovative performance. This idea was further elaborated in (Swift 2018). The author proposed an idea that board members educational background is especially important for companies operating in manufacturing industries (e.g. chemical manufacturing), since innovation activities there are more intensive in comparison, for example with service companies, secondly, they are more complex and complicated to understand. That is why directors with technical background might become for such companies a valuable asset. Moreover, the author suggests that directors with Ph.D. in technical field might contribute even more. As substantiation he cites that, from resource-based view, such directors have more profound and wide knowledge about the field, in which company operates. Moreover, they pay close attention to cutting-edge technologies emergence, which the company might use in its innovation activities. Thirdly, Ph.D. directors due to similarity of their background are more likely to establish contacts with each other, which may provide them with additional source of information and be helpful in the process of R&D investments strategy implementation, aiding to find appropriate provider of this or that technology, for instance. Boards of directors with advanced academic expertise are able to span the gap between business and academia, bridging structural holes. Therefore, companies with such boards are thus likely to be more creative and productive. If to look at such directors from the perspective of agency theory, it should be said that directors with advanced technological expertise that is related to the technological domain of the firm are expected to be superior monitors of the firm's R&D. Due to their expertise and specialized knowledge, such directors can help management to identify and terminate underperforming R&D initiatives, thereby preventing significant losses and thus improve not only R&D investments and innovations activities, but may be the whole company's performance.

Highlighting interdependence of board's human capital and social capital through the point that commonality of academic background serves as a basis for ties establishment, the author also makes emphasis on Ph.D. directors' interlocks. They propose an idea that such ties between companies are one of the most valuable sources of relevant information encouraging innovation activities.

The author proves his hypotheses about positive relationship between number of directors with Ph.D. in chemistry, biology and biochemistry and R&D investment intensity on a sample of U.S. public companies operating in chemical manufacturing.

In accordance with this research, next hypothesis is formulated in the following way:

Hypothesis 4: Advanced technological expertise is positively related to R&D investment intensity

In addition to board's capital elements that were discussed above, there are a lot of articles that investigate relationship between other board capital's components and R&D investment intensity. However, the authors do not explicitly state that this or that characteristics are the elements of human or social capital. Nevertheless it is important to analyze such characteristics.

For example, (Wincent et al. 2010) explore the impact of network board capital on innovative performance of strategic SME networks, the groups of SMEs that cooperate in order to improve their innovative performance (Wincent 2008). Presence of state officials on board can be important in terms of providing a government support to a company, for example, access to special government supporting programs for innovation companies in particular industries. Their presence on board will make company somehow feel more confident about making risky investments in R&D. It is assumed that government will be able to support innovations' development and implementation, and it will give a helping hand in case of unsuccessful R&D investments. Moreover, the general government policy orientation towards innovativeness will probably encourage companies through directors of this type to invest more in innovation activities.

Among other characteristics the board size is crucially important for innovation activities: big boards may significantly enlarge board's knowledge pool, enhance its store of competences, experience, increasing the opportunity for directors to investigate R&D investments' prospective more thoroughly and make detailed plans on these investments implementation. Empirical proves of these hypotheses were found by (Dalziel 2011). Among recent papers (Ashwin 2016) and (Chou 2016) also concluded that there is a positive relationship between board size and R&D expenditures, having distinguished board's functions of communication channels with external environment; counsel in specific realms, legitimacy and preferential access to necessary resources. At the same time, some studies (Chen 2012, Balsmeier 2015) demonstrate that large boards impede the possibility to find a consensus about board decisions. For such a risky and complicated decision as investments in R&D directors may refuse to make investments or will allocate much less money for this purpose.

Higher frequency of board meetings may be an indication of more serious attitude toward analysis of strategic alternatives for a company further development, including investment opportunities related to R&D. Board members devote more time to investigation of complicated innovations, advantages they will potentially bring and the process of their development and implementation as it stated in (Zahra 1990, Chiang and He 2010, Chen 2012) Nevertheless, (Wincent et al. 2010) found that board meetings frequency negatively moderated the effect of board diversity on innovative performance of networks, explaining it by the fact that too many

meetings favor directors to change company's strategy that is negative for a long-term R&D investments.

Not being directly the element board's intellectual capital board independence, which means the portion of independent directors (not affiliated to company in other way than by being board members), is one of the key characteristics of the board. It is believed that independent directors are able to more objectively and cold-bloodedly estimate firm's risks, having a look from outside. Moreover, independent directors are thought to be able to reorganize board's work, they are expected to contribute to strategy development, provide non-biased monitoring of executive directors' actions, build a system of internal control and risk-management. Independent directors' networks, specific knowledge may enormously contribute to board's decisions quality and help to achieve set goals, especially if company operates in a knowledge-intensive field.

This way, it is obvious that independent directors play an important role in company's strategic decisions about R&D investments (Baysinger and Hoskisson 1990, Gilson and Kraakman 1991, Hill and Snell 1988, Hoskisson et al. 2002).

One of the ideas supporting negative relationship between board independence and R&D investment intensity is that independent directors' initiatives on board are often restricted by the lack of information about company's activities, because these board members do not work in company and have limited access to information provided by management, for their lack of connections with anyone from the company. Therefore independent directors are reluctant to make decisions about R&D investments, which are usually associated with higher risks. Being unable to judge if a company is able to take such risks, independent directors are not inclined to heavily invest in R&D. (Yoo T. and Sung T. 2014). Driver C. and Coelho Guedes M. J. 2012 focus in their study on independent directors' control function. Traditionally presence of independent directors on board is associated with enhancing of board control function, particularly the financial one. Innovation activities as a matter of fact need a lot of investments, which are long-term and the returns are very uncertain. Therefore independent directors are supposed to prevent company from huge money spending, including those in R&D (Baysinger and Hoskisson 1990, Baysinger et al. 1991). This way, directors are focused more on short-term financial outcomes, rather than on longer-term performance results.

The other group of researchers found positive relationship between board independence and R&D investment intensity to be positive. In (Honoréa et al. 2015) it was suggested that being related to a company only as board members independent directors on contrary do not hesitate to promote enormous R&D investment, because in case they fail, such directors will not

lose their jobs or shares, for they are not company's beneficiaries (affiliated to them). Moreover, (Gou 2014) assumed that as protectors of shareholders' interests independent directors are more oriented towards the long-term perspective which implies innovations and R&D investments, because in ever-changing reality competitive advantage becomes dynamic. Thus, independent directors encourage the board to invest in R&D more intensively. (Chen 2012) proposes the idea of independent directors having a great store of knowledge, experience and wide networks that may enormously contribute to more successful implementation of R&D investments strategies. According to resource dependence theory independent directors are considered as providers of valuable resources to the firm (Pfeffer and Salancik 1978). As it is noted by (Kim and Kim 2015), independent directors could be a key source of innovation. For this reason companies with higher level of board independence are more inclined to invest in research and development.

Second chapter conclusions

This way, we may conclude that board of directors is one of the main internal mechanisms of corporate governance in public companies, which serves as intermediary between shareholders and managers. It specifically concentrates on strategic perspective of company's development including investments in R&D. In spite of the fact that the concept of company's intellectual capital has been greatly developed in scientific literature, a little attention has been paid to intellectual capital of board of directors. At the same time, many studies investigated the relationship between board's capital and company's innovation activities without explicitly stating the term. In comparison to firm's intellectual capital, board's one consists only of human capital and social capital, which are closely interdependent. Among the components of board's capital in terms of innovation activities the most important ones are board tenure, multiple directorship and education. All of them should be viewed from both resource dependence view, which emphasizes importance of resources provision and agency theory, which concentrates on monitoring functions.

3. EMPIRICAL STUDY OF RELATIONSHIP BETWEEN BOARD'S INTELLECTUAL CAPITAL AND FIRM PERFORMANCE

3.1. Methodology and sampling

To test the hypotheses proposed in the previous chapters, which is basically econometrics research whose purpose is to find relationship between board of directors' intellectual capital and firm performance through decisions about investments in innovations, we will use two regression models. The first one aims at identifying the relationship between different elements of boards' intellectual capital and innovation activities:

$$RD_{it} = \beta_0 + \beta_1 * LEV_{it} + \beta_2 * COMPSIZE_{it} + \beta_3 * BD_SIZE_{it} + \beta_4 * TENURE_{it}^2 + \beta_5 * TENURE_{it} + \beta_6 * PHD_RD_EDUC_{it} + \beta_7 * MULTIPLE_{it}^2 + \beta_8 * MULTIPLE_{it} + \varepsilon_{it} \quad (1)$$
$$i = 1, 2, \dots, N; t = 2010, 2011, 2012, 2013, 2014$$

In accordance with the analysis made above, to measure innovation activities we use the portion of R&D investments in company's sales.

The second model serves for testing the relationship between innovation activities and firm performance and looks the following way:

$$ROA_{it} = \beta_0 + \beta_1 * LEV_{it} + \beta_2 * COMPSIZE_{it} + \beta_3 * RD_{i(t-3)} + \beta_4 * RD_{i(t-3)}^2 + \varepsilon_{it} \quad (2)$$

$$i = 1, 2, \dots, N; t = 2013, 2014, 2015, 2016, 2017$$

In the model (2) we took ROA ratio for the firm performance indicator based on the research made previously.

Both models are linear, however, in each of them there are squared variables, describing multiple directorships, tenure and investments in R&D, which was designed respectively to hypotheses that propose nonlinear relationship in these cases. To be more precise squared variables indicate inverted U-shaped form of a relationship, which is logical not only based on theoretical background, but also from the perspective of common sense. First of all, as it will be seen in the table below, board's tenure is measured in years, which director spends in company. Assuming positive linear relationship between it and R&D investment intensity we imply that director will be able to live forever and sit infinite number of years, which is impossible, since all humans have limited life duration. However, inverted U-shaped type of relationships indicates that there is a peak in number of years director will be able to sit on board. Similar explanation can be given regarding multiple directorships. This variable is measured in number of position nonexecutive director occupies, so it is natural that there will not be hundreds of them

contributing to higher investments in R&D, as it would be implied by positive linear relationship. It is more realistic to suppose inverted U-shape relationship, which means existence of maximum number of directors' positions. As for other variable, board size of course can not be infinite, and there are certain limits upon number of directors on board established by law. For example, Institutional investors' committee established the size from 5 to 15 (Quantitative composition of board of directors 2018). This way, it is more important to define, whether large boards or small boards are associated with intensive investments in R&D. Moreover, the importance of board size for strategic decisions about innovations was discussed in previous chapter.

One more important remark about the first model is that under variable *MULTIPLE* is understood the average number of positions nonexecutive directors occupy on boards of other companies. The distinguishing feature is that nonexecutive directors are taken into account separately from executive ones. The main reason for that is that executive directors or in other words those directors who work in the company are more closely connected to it, since they get salary and other financial and nonfinancial compensation from the company. Being additionally interested in company's less intensive investment in R&D, for it might decrease their remuneration, since financial resources will be allocated for R&D investments, executive directors are more biased in their decision-making process. This way, it becomes logical to consider multiple directorships of executive and nonexecutive directors separately. Moreover, decisions taken by executive directors are additionally influenced by their financial interest in the company, which makes them less connected to the number of positions they occupy on boards of other companies.

Finally, in accordance with previous research, variable *PHD_RD_EDUC* is designed to measure advanced technological expertise of directors in R&D. To be more precise it measures the portion of directors on board who not only graduated from technological or technical major, but who really have advanced knowledge in the field, which is substantiated by their PhD.

If to speak about control financial variables, both company size and financial leverage are included in the first model, since they are closely related to R&D investment intensity for economic reasons. First of all, company size, which is measured as natural logarithm from total assets, allows for differentiating between companies with various size, which supposedly have allocate different sums of money for innovation purposes. However, by taking into account company size, this problem is eliminated. One more important point about this variable is that in accordance with research practice it is measured not simply as total assets, but as natural logarithm from its sum. It is made in order to align this variable to others, some of which vary

from 0 to 1 and others have values not more than 50. If to leave the sum of total assets as it is (in billions and trillions of rubles) it will result in a situation, when dependent variable will be explained only by company size, other variables' input will become negligible.

Secondly, speaking about financial leverage representing capital structure of the company in terms of its belonging to creditors and shareholders is crucially important. Even taking into account that R&D investment measurement used in this study reflects only expenses made on company's own money without debt capital, financial leverage is still influences them. It is logical to assume that highly risky R&D project firm will be financing with its own capital in order to protect itself from being deeply in debt, if the investment does not pay off. That is why it is natural to assume that company, which is already burdened with debt, is unlikely to allocate great sum for R&D investments in comparison with company, which has not taken too many obligations. In any case it is obvious that financial leverage is a point, which should be taken into account while deciding on R&D investments that is why it is included in the first model.

Finally, board size being a traditional control variable in models investigating any board of directors' characteristics is additionally included into the model. Moreover, its importance in terms of gathering intellectual capital to facilitate R&D investments was shown previously.

What concerns the second model, it involves variable indicating company's innovation activities in form of investments in R&D. However, the variable in accordance with the logic of researches on the topic does not simply reflect the amount of money, company spent on R&D, it shows the ratio of that sum to total company's sales (revenue). It was made on purpose to make the indicator relative in order to reflect how intensively company invests in R&D. For example, a big corporation with great earnings may allocate for R&D a small sum of money in comparison with its total budget, however, this sum will still be more in absolute figures in comparison with the sum, which medium-sized company allocates for R&D. At the same time for this medium-sized company the money allocated for R&D may count for third or half of its budget. In this case we see that the second company, though spending less money on R&D is more intensive in investments, which are restricted because of its size. As long as company's intensity in making R&D investments matter we introduce this particular ratio.

In the second model as well control financial variables consists of company's size and leverage. The importance of company size for the value of its ROA is explained again by the fact that big corporations are able to generate huge profits, even taking into account relevant nature of ROA ratio, while smaller firms are supposedly earn fewer profits. One more important issue with ROA is capital structure, which is reflected by ratio of debt capitals to company's own one or, what we have in our case assets. There are a lot of ways in which financial leverage may

affect profits, for example, company can borrow money for supporting its operational activities or for renovation purposes of its equipment, which is again related to operation activities and eventually impacts profits. On the other hand, great amount of debt may indicate that company's state of affairs is not promising: it uses new loans to pay the old ones because of different problems. In this case it is natural to assume that such company's profits are unlikely to be high, or are even negative.

Return on investment ratio (ROA) itself is calculated according to the following formula, in alignment with Damodaran's approach:

$$ROA = \frac{Net\ Income + i * (1 - t)}{Total\ Assets}$$

In the formula i indicates the interest payment for borrowed funds, while t - is a tax rate. One more important detail about the second model is that it includes a time lag between R&D investments and company's performance expressed by ROA, company size and leverage. It was made in accordance with previous researches on the topic and reflects specificity of R&D investments, which are long-term and are unlikely pay off immediately. On the other hand, enlarging the lag between investments in R&D and firm performance may bring a lot of other factors resulting in change of performance and R&D investments themselves. That is why in alignment with (Pantagakis, E. et al. 2014, Huang C. and Chen S. 2010, Beld B. 2014) 3-year period was chosen.

The detailed description of each variable is presented in the table below:

Table 2

Variables' description

Variable	Description
<i>RD</i>	Relation of year expenses on successful R&D to the amount of revenues. Describes company's innovation activity.
<i>LEV</i>	Financial leverage calculated as relation of company's total liabilities to total assets.
<i>COMPSIZE</i>	Natural logarithm of total company's assets. Expresses company's size.
<i>MULTIPLE</i>	Average number of directors' positions per one director, nonexecutive board members of this company occupy in other firms.
<i>BD_SIZE</i>	Board size defined as number of directors on board.
<i>TENURE</i>	Average directors' tenure in a particular company. Describes director's experience in the field of company's activities.

<i>PHD_RD_EDUC</i>	Share of directors, who have technical educational background (preliminary engineering) and received their PhD in it. Calculated as a relation of number of directors with technical expertise and PhD to total number of directors on board. Expresses advanced technological expertise.
--------------------	---

As for gathering data to run econometric analysis, we needed information about board of directors and companies financial results. The firms relevant for the topic in question were supposed to meet three requirements:

- they had to be founded and registered in the Russian Federation;
- in terms of legal incorporation they had to belong to open joint stock companies (OJSC) in a period from 2010 to 2014;
- all companies had to carry R&D expenses in a period 2010 – 2014.

The first point is closely connected to the research gap of this paper to investigate board's intellectual capital in Russian companies, which has not been done before. The reason for requirement number two is that joint stock companies in comparison with other forms of legal incorporation in Russia that establish board of directors. Open joint stock companies existed in Russia till 2014 contrary to closed joint stock companies were obliged to organize this corporate body, that is way among joint stock companies, only open ones were selected. In 2014 in accordance with reform open joint stock companies were forced to meet new, stricter requirements for listing on stock exchange and be renamed into public joint stock companies (PJSC). Those companies that refused to do it were obliged to become nonpublic joint stock companies. As long as for the first model from the period from 2010 to 2014, we use the term "open joint stock companies" even for those companies that later became "public joint stock companies". If to speak about the third requirements it is natural with a view of the topic of the current research, which specifically focuses on innovative companies, which are defined, as it has been discussed previously in accordance with the fact of spending money on R&D.

The information about intellectual capital of board of directors was gathered from firm's annual and quarterly reports, which they as public companies are obliged to publish in open sources (company's web-sites) on regular basis. Financial information was also obtained through annual and quarterly financial reports. In cases when the information could not be found in open sources, it was gathered with the usage of special databases called SKRIN and SPARK, the access to which is provided by GSOM library.

As for R&D investments, the figures were gathered in company's quarterly reports. In comparison with open joint stock companies' annual report, which differ a lot from company to company, quarterly ones are more unified and include information strictly defined by the law.

One of the subsections of Section 4 “Information about issuer’s financial-operational activities” is called “Information about issuer’s policy and expenses in the field of scientific and technical development in terms of patents, licenses, R&D” was particularly dedicated to the topic. However, it includes information only about R&D investments, company made using its own money. In other words, it does not include data about investment in R&D, which company made with loans, credits or any other type of debt capital. This way, such information may not give a full picture about the scale of company’s innovative activities, but this information serves as a good proxy for total R&D investments sum, since for companies operating without debt capital the amount of money will be exactly the same. Secondly, it has been said that investments in R&D are associated with high risk, for which company often allocates an excess of money, it has, for if it takes a loan for that, the money will not pay off and their sum will probably be huge, which in case of R&D investments failure may cause losses. Thirdly, Russian public companies are not obliged to disclose the full spending on R&D. One more indicator of expenses on innovations, which they make public, is in the balance sheet and called “Results of R&D”. It was introduced in 2011 and reflects capitalized R&D expenses, which come only from investments in R&D that were ended up successfully. This way, company may spend huge budget on R&D, but only a tiny portion of this investments, which are indicated by this figure may result in success, which means innovation. This way, R&D spending made by company’s owned money is seen as a more appropriate metric for the purpose of current research.

In the beginning the sample consisted of 100 firms meeting the requirements above. However, because of data lack for some of them and after outliers’ removal, there left only 68 companies and 234 observations (company x year) for the period from 2010 to 2014. An industry distribution of companies in the sample occurred to be the following one:

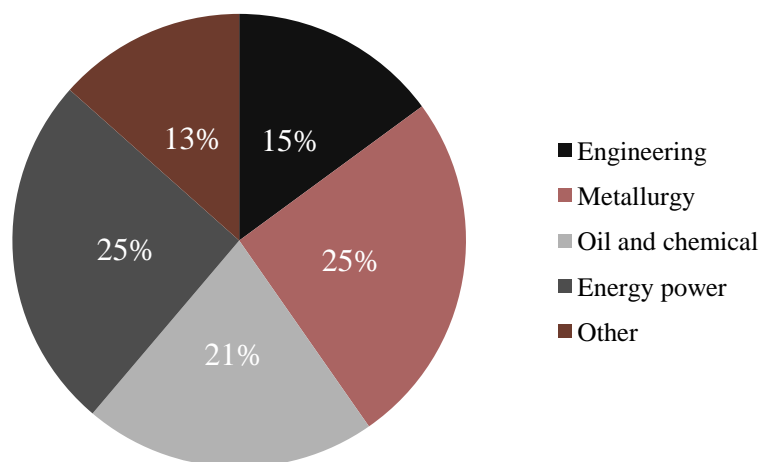


Figure 5. Industry distribution of companies in the sample

From such distribution we may derive that innovation activities in Russian public companies are mainly driven by energy power, engineering, metallurgy, oil and chemical sectors, since they obviously prevail. In addition to these industries, companies from logistic, development, tire production and internet services were included in the sample. If to compare these results with the ones obtained in (Berezinets et al. 2013) dedicated to investigation of relationship between board of directors' structure and firm performance of Russian open joint stock companies, the major part of their sample as well counted for companies from these three industries. Companies from fuel and energy power sectors made up a half of all companies, 13% were occupied by firms form metallurgy, and chemical sector companies composed 11% of the sample. Both of these distributions reflect the specificity of Russian economy, concentrated on extraction of natural resources as it was said before.

3.2. Econometric analysis

The first step of econometric analysis is analysis of descriptive statistics. It is presented in the tables 2 and 3 below, and in the appendices 1 and 2:

Table 3

Descriptive statistics of variables in the first model

Variable	Sample mean	Sample standard deviation	Minimum value	Maximum value
<i>RD</i>	0.130	0.665	$5.00 \cdot 10^{-4}$	6.732
<i>LEV</i>	0.506	0.260	0.030	1.064
<i>COMPSIZE</i>	24.603	2.114	18.332	29.684
<i>BD_SIZE</i>	10	3	4	15
<i>TENURE</i>	3.324	1.980	0.500	10.278
<i>MULTIPLE</i>	3	3	0	11
<i>PHD_RD_EDUC</i>	0.105	0.122	0	0.533

Table 4

Descriptive statistics of variables in the second model

Variable	Sample mean	Sample standard deviation	Mimum value	Maximum value
COMPSIZE	24.882	2.116	19.097	30.036
LEV	0.563	0.383	0.002	2.915
ROA	0.027	0.116	- 0.663	0.477

The sample mean of tenure on board of innovative companies in 2010 – 2014 occurred to be equal to a little bit more than 3 years. However, the maximum number of years, directors spent on their posts was more than 10 years. It is also should be clearly understood that it is not just the maximum tenure, which happened to be one or two times, this is the average number of years per director. The company, which has such a long living so to speak board of directors is PJSC Surgutneftegas. In 2014 this company finally changes the composition (Kommersant 2014), but till this time it has a distinct director profile of a male 60.5 years old working in the industry for approximately 30 years and having gone through a long way from engineer or even common worker to member of the board. It is also worth noticing that almost all these directors have engineering education. Such kind of board composition in terms of connection between board's intellectual capital and investment in R&D makes think that such a profound knowledge or expertise obtained through special technical education, huge experience of working in oil sector and particularly in PJSC Surgutneftegas may encourage directors make significant investments in R&D, since they are experienced in them, have understanding where company needs to go and how R&D investments can be implemented. On the other hand, having worked for so many years in the company and sitting on board for more than 10 years directors may feel unwilling to change anything preserving their status quo.

In comparison with such approach to board's composition in the sample there are such companies as OJSC Omskshina, OJSC Vologdaenergosbyt, OJSC Yaroslavy Shiny Zavod, whose boards' tenure counted only for 0.5, which indicates a significant rotation. However, it might occur for a bunch of different reasons, one of the most probably of which is that all these companies are subsidiaries of big corporations and board in them changes because of rotation in management of the mother company, from which they derive.

If to look at industry distribution in terms average board tenure (Fig. 6), it can be seen that tenure does not vary significantly except for energy power sector. The high level of turnover in this industry may be associated with the fact that all energy power companies in Russia are owned by two big corporations FSK EES and RusHydro directly or indirectly. This way, board of directors in these companies consists of management of their “mother” companies. High rotation of management explains comparatively shorter board tenure for these companies.

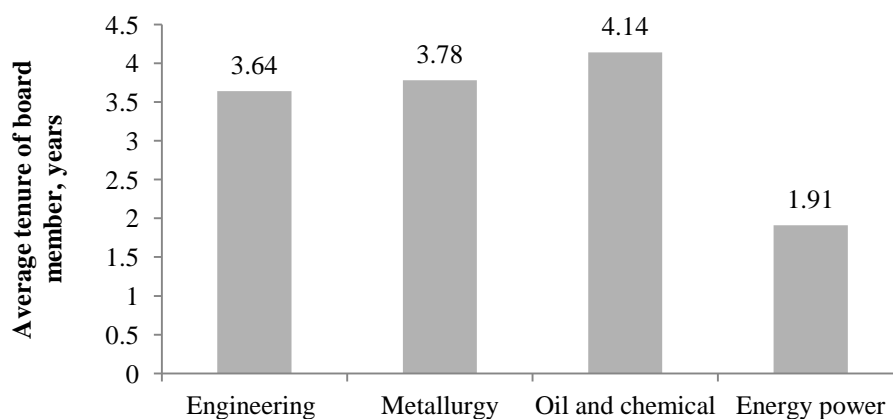


Figure 6. Industry distribution of average board tenure

The following graph illustrates dynamic of changes on average board tenure in time. It is clearly seen that it becomes shorter year to year, which might reflect the necessity for changes, which innovations companies need and which new directors are supposedly to bring:

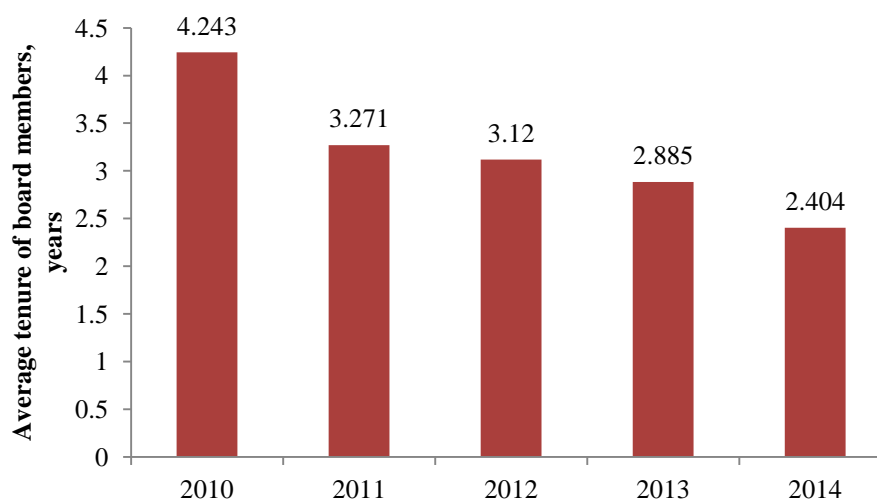


Figure 7. Year distribution of average board tenure

According to the results of descriptive statistics, the mean number of positions nonexecutive directors in innovative companies occupy, equals 3. However, the maximum number reaches 11 positions, which takes place with directors of OJSC Gazprom-Neft'. One of the probable reasons is that this company forms part of Gazprom Holding, which consists of more than 30 companies. In addition to it, OJSC Gazprom-Neft' itself has more than 10 subsidiaries, on the board of which directors of the company are likely to sit in order to smoothly run the mother company's policy. This way, members of its board logically sit on boards of these companies affiliated between each other. Another concern that arises here: are these directors really involved in activities of all the companies? It seems hardly possible to actively and equally participate in discussion and debates of 11 boards, even taking into consideration the fact that

companies belong to the same industry. However, in Russian companies, it sometimes a common practice that board member especially in subsidiary really fulfill his or her duties. Boards of directors in such companies do not really work as they are supposed to do and directors occupy their positions nominally. With a view of this fact, the results of descriptive statistics for multiple directorships for Russian companies greatly differ from descriptive statistics for companies traded on NYSE (Bravo et al. 2017). In this research, the average number of positions directors occupied on other boards did not even reach 1.

In comparison with OJSC Gazprom-Neft' in other subsidiaries, which do not have their own "daughter" companies, so to speak, usually board members do not have a lot of positions. For example, directors in already mentioned OJSC Omskshina do not sit on a board of any other company. At the same time 0 positions on other boards may be encountered among directors of big companies. For instance, in PJSC Surgutneftegas, which does not have subsidiaries incorporated as joint stock companies, directors hold their sits only on the company's board. However, it might be valuable if directors with such an enormous experience in the industry shared their knowledge and their skills participating in the activities of other boards.

If to look at industry distribution of busy directors, it reflects a difference between companies of oil and chemical, energy sectors and such industries as engineering and metallurgy, which have fewer average numbers of positions (Fig.7). It again might be connected to the fact that companies of former two industries are more likely to be a part of a holding with many affiliated firms, on which boards they sit. Contrary to it, companies from engineering sectors and metallurgy are less likely to have subsidiaries or at least subsidiaries, which are registered as joint stock companies in order to have such body as board of directors. On the other hand, it might indicate that the high number of positions signals about profound expertise and knowledge directors possess, if they are invited to so many boards.

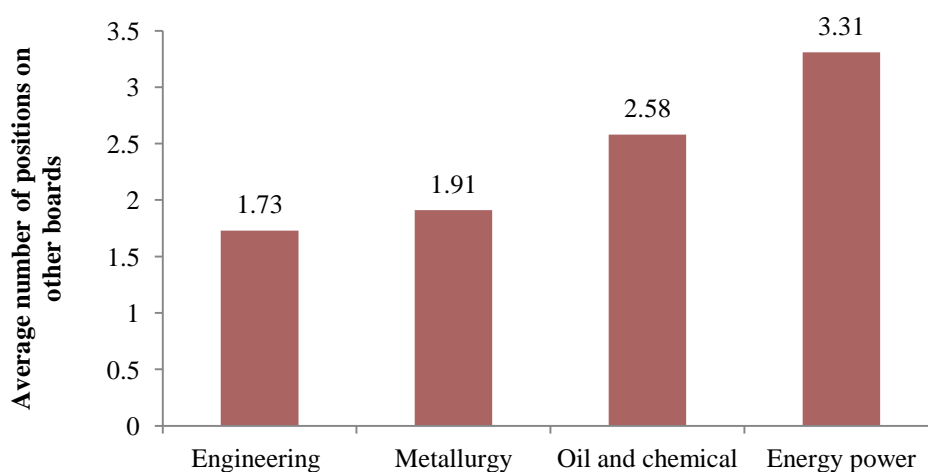


Figure 8. Industry distribution of average positions on other boards

What concerns advanced technological expertise under which we understand in accordance with (Swift, 2018) educational background in technical sphere and corresponding PhD, it should be said that on average 10.5% of board members had this kind of expertise. Such a figure might be attributed to the fact that companies of almost all industries in the sample relate to technical sphere, so for them it is quite logical to have many technicians on board, however, only few of them have a scholastic degree, since the majority of people with PhD prefer pursuing academic career at universities and research centers. At the same time it is not a common practice of Russian companies to involve in board's activities academicians, which is why the portion of them on board is relatively small. Nevertheless, there are companies, in which academicians with technical education occupy the majority of directors' positions, which is confirmed by example of PJSC Tatneft', in which there are 53% of such directors on board. A probable reason for such a large portion of highly educated directors is that oil and chemical sector is more knowledge-intensive in comparison with other industries, requiring more technical expertise. It seems to find substantiation with a view of industry distribution of advanced technological expertise, which is presented on the graph below:

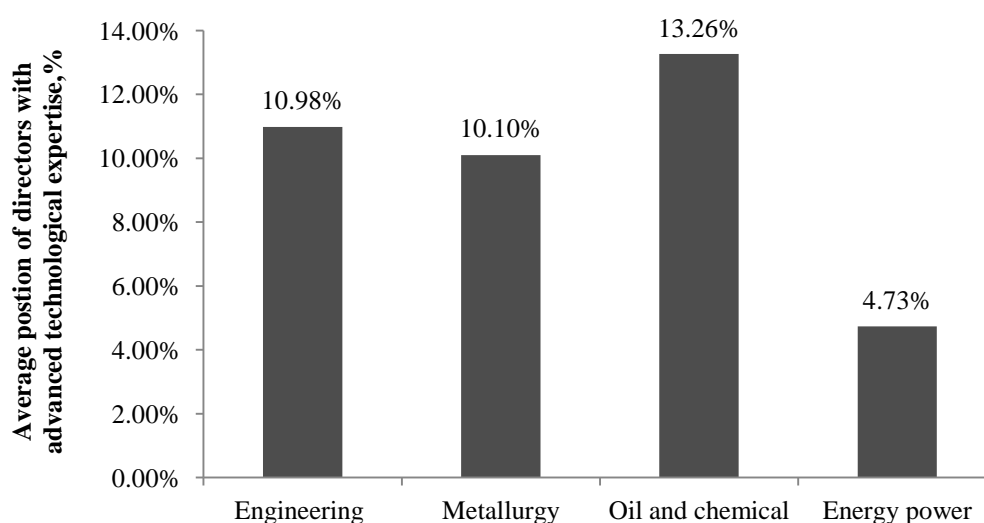


Figure 9. Industry distribution of average portion of directors with advanced technological expertise

As can be seen, oil and chemical sector on average has more directors with technical education and PhD, which clearly dominates over energy power industry, which seems to be less knowledge-intensive. It is also confirmed by examples of companies that do not have directors with technical educational background and PhD. Many of them like OJSC Orelenergosbyt, OJSC Vologdaenergosbyt, OJSC Yakytskenergosbyt belong to the sector of energy power.

If to speak about particular examples of directors, who not only have technical education, but who also made scientific career and are known for their researches, we should give an

example of A. Shuster. Being a member of Pharmstandard, company, specializing in medicine, he is an author of more than 40 scientific papers and 10 patents in biotechnology. In 2011 he was awarded by a Prize of Russian Government in the field of science and technology. Another bright example is D. Pumpiansky, who is a board member of Sinarskiy trubniy zavod. He got PhD. in technical science and economics, wrote 4 monographs and 70 scientific papers in the field of metallurgy and physics of metals.

Commenting on other results of descriptive statistics related to board of directors, it should be said that the average board size counted for 10 members, which in comparison with in results of (Berezinets et al., 2013), in which this metric equaled 7, is higher. The difference of innovative companies from all Russian companies in this aspect may be attributed to the fact that innovation activities are more likely organized by big companies with higher number of shareholders, for which it is established by law that board size should be larger.

The scale of R&D investment in the sample was heterogeneous. This way, the average portion of R&D investments in sales reached 0.8%. At the same time maximum value this ratio achieved was 673%. It was obtained by the company called Platform UTINET.RU, which is specializing in software. Logically this company being a high-tech one constantly needs to innovate to stay competitive that is why the portion is so high. However, in absolute figures its spending of R&D, though from owned capital counted for 141 mln rubles. In comparison with it, OJSC Transneft' allocated for R&D investments a little bit more than 54 mln rubles, however, it made up only 0.0000005% of its enormous sales of more than 700 bln rubles. So this company, having great potential invested in R&D less intensively than company with lower sales, but whose industry obliges it to do so. One more important point is that we take into account as it has been said above only those expenses on R&D that were done from company's own capital not taking into account debt financing. This way, the whole picture might look a little bit different if to consider those expenses as well, but because of impossibility to reach them we have to stick to the figures we obtained.

If to compare these results with the ones obtained by (Pantagakis E. et al. 2014) in which the average share of R&D investment in sales equaled 16.7%, they differ significantly. However, this incompatibility may be explained by the industry distribution of companies in sample. The authors considered companies operating in IT industry, for which innovations (which was confirmed by an example above) are the key success factor. In Russian realities there are not so many companies from IT, to say nothing of the public ones. For the majority of companies in the sample these expenses are important and helpful, but not vital. Moreover, the quality of results and scale of effect from innovations between different companies and industries are not always

comparable. For example, company may spend millions rubles on R&D, but obtain innovation, which implemented in operation activities will bring not such great improvement in its performance. Simultaneously another company may invest comparatively low sum in R&D, but as a result will obtain innovation, which will boost its performance indicators. Of course these examples are polar ones, but there is still a possibility of similar cases in practice. Moreover, obtained results of companies' innovation activities are confirmed by analysts, which state that "Russian business on average spends 1% of its turnover for R&D purposes", which is one of the major problems in Russian economy (Rosnano news 2014).

The obtained results also witness that average return on assets, which used as performance indicator occurred to be equal to 2.7%, which is lower than analogous indicator in already mentioned (E. Pantagakis, D. Terzakis, S. Arvanitis, 2014), in which it reached 6.2%. However, comparatively low value of ROA in the sample can be explained by the fact that many companies especially in 2014 because of financial crisis got negative financial results. A quite peculiar yearly distribution of ROA values (Fig. 10) might be attributed to the economic crisis and sanctions imposed on Russia in 2014 followed by recovery of the national economy by 2016-2017.

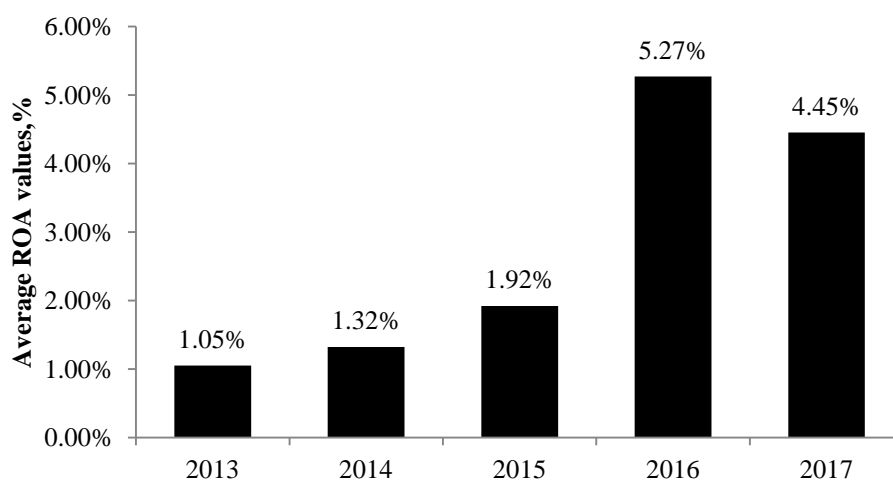


Figure 10. Average ROA values according to particular year

Among companies with the lowest ROA is PJSC AVTOVAZ, while OJSC Surgutneftegas and PJSC Tatneft' obtained high value of ROA. If to look at the overall ROA values distribution among different industries it will look the following way:

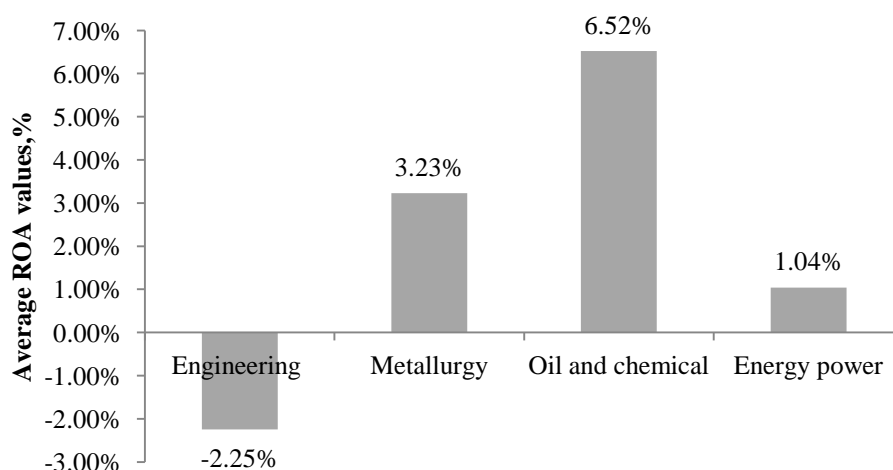


Figure 11. Average ROA values according to particular industry

As can be seen in oil and chemical industry on average ROA values are higher than in other industries, which may be attributed to the industry specificity. Other possible reason is that such prevalence in terms of performance may be the result of more intensive or less intensive investments in R&D. As we remember OJSC Transneft' occurred to be the company, which invested in R&D less intensively across the whole sample. However, if to look at board's intellectual capital components in oil and chemical industry we discussed above, it can be seen that in this sector board's tenure is comparatively higher than in others. Moreover, the number of position directors occupy also is one of the highest as well as the portion of directors who have advanced technological expertise. Comparing these results with the fact then across the sample companies from oil and chemical sector had the on average the highest ROA ratio we may suppose that it can be attributed to the intellectual capital profile of their boards of directors. In order to be sure, the regression analysis was needed to be done.

Regression analysis was made in two steps. At the first one the parameters of the model number 1, in which portion of R&D expenses in sales was dependent variables, were identified (tables 5, appendices 3-7). The second stage dealt with the second model, in which ROA ratio represented dependent variable (table 6, appendices 8-13). It also should be noticed that for each model firstly baseline models, which included only financial variables (leverage and company size with board size for the first model), were constructed. It was made to demonstrate that economic laws according to which these financial variables are considered to be related to R&D investment intensity and ROA actually work with the gathered data. Additionally, constructing the first model we gradually added different elements of board's intellectual capital starting from the social one in order to more clearly identify the contribution of each of the elements, which might be helpful for further research. Moreover, it showed that the chosen types of models are

best at describing relationships between the variables. The results of regression analysis for the first model are presented in the table below:

Table 5

Results of regression analysis of the first model

Variable	RD					
	Baseline model	1	2	3	4	5
<i>TENURE</i>	-	-	-	-	0.011	0.165**
<i>TENURE_SQ</i>	-	-	-	-	-	-0.017**
<i>PHD_RD_EDUC</i>	-	-	-	1.377***	1.415***	1.440***
<i>MULTIPLE</i>	-	0.030*	0.116**	0.116**	0.114**	0.117**
<i>MULTIPLE_SQ</i>	-	-	-0.012**	-0.013**	-0.013**	-0.012**
<i>BD_SIZE</i>	-	-0.021	-0.025	-0.036**	-0.037**	-0.037**
<i>LEV</i>	-0.540***	-0.537***	-0.514**	-0.441**	-0.438**	-0.362**
<i>COMPSIZE</i>	-0.068***	-0.062**	-0.053**	-0.066**	-0.062**	-0.059**
<i>CONS</i>	2.084***	2.052***	1.774***	2.014***	1.979***	2.113***
<i>R²</i>	0.076	0.084	0.106	0.160	0.157	0.174
<i>p-value</i>	0.000	0.000	0.000	0.000	0.000	0.000
<i>N</i>	234	234	234	234	234	234

Note: *, **, *** indicate significance at 10%-, 5%-, 1% levels of significance respectively

All the presented models are significant and the coefficients in front of each of the variables in the last (5) model are significant. This way, it should be said, that since parameter in front of *TENURE_SQ* is negative, we accept the second hypothesis, which states that there is nonlinear relationship between board's tenure and R&D investment intensity. To be more precise this relationship has a shape of inverted "U", which is illustrated by the graph below:

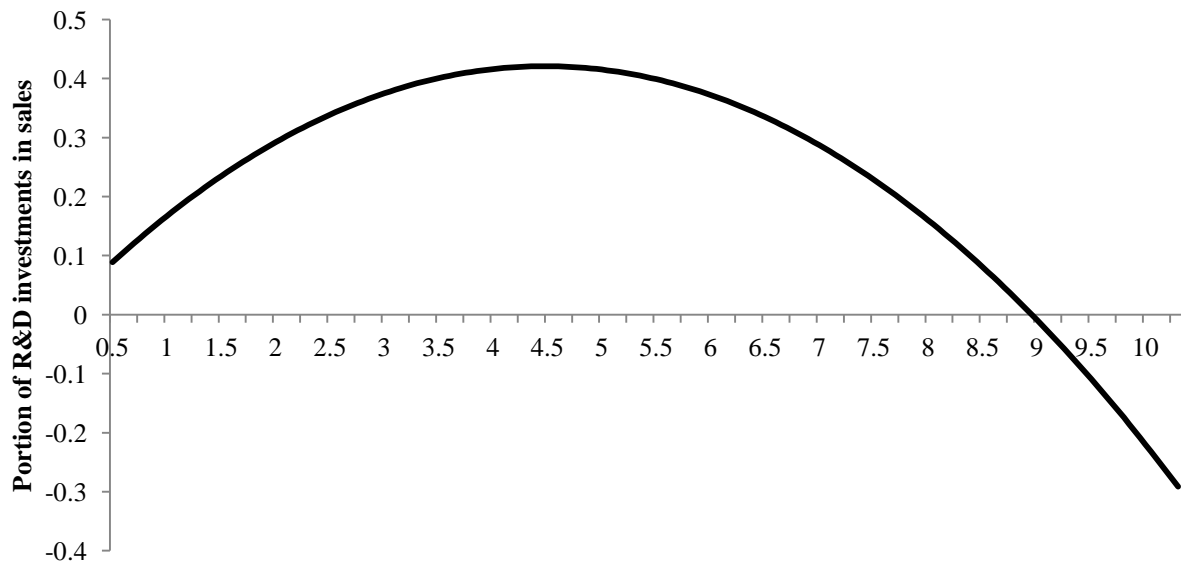


Figure 12. Relationship between board's tenure and R&D investment intensity

The peak of R&D investment intensity all other variables staying equal as can be clearly seen from the graph is reached when board's tenure approaches 4.5 years. It means that when directors just start to sit on the board, they do not know either company or industry, in which it operates. That is why they prefer not investing intensively in R&D, since those investments are more risky and usually need a longer period to pay off. As time passes directors learn more information about the company, understand its strong and weak points, comprehend directions of further development, start to make out industry dynamic and etc., they tend to invest more intensively in R&D. However, being on board more than 5 years directors become reluctant to change anything, preserving their current status quo. Sometime it might be that unsuccessful experience with investing in R&D prevents them from making new investments in this direction.

From significance of the parameter in front of variable *MULTIPLE* we conclude that there is nonlinear relationship between the number of positions on other boards, nonexecutive directors hold and R&D investment intensity, thus accepting the hypothesis number 3. The maximum portion of R&D investments in sales is achieved ceteris paribus, when the number of positions equals to 5, as it is shown on the graph below:

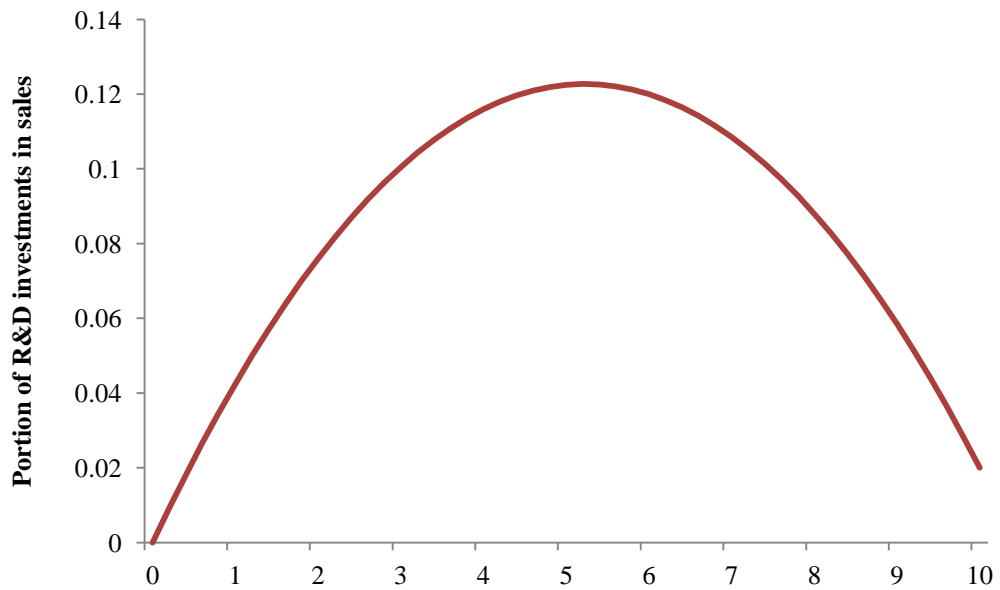


Figure 13. Relationship between multiple directorships and R&D investment intensity

This way we can conclude that having no positions on other boards, nonexecutive directors are able to dedicate all their time and efforts to serving their duties on the board, however, they have limited information sources mainly restricted by the company on whose board they sit. In comparison with them, those directors who are additionally involved in board activities of 1-5 more companies have access to more various and highly likely more helpful information flows, which they might use for the good of the firm in question. Moreover, they gain wide network of contacts on other boards, which also may be of help in realizing complicated and expensive investment in R&D through finding unique specialists in narrow filed, for example. On the other hand, when the number of positions on other boards starts increasing 5 gradually directors begin experiencing lack of time to perform their duties. It becomes hard for them to be fully immersed in activities of all the companies and use their network to facilitate R&D investment processes. More than that they are likely to afraid to allocate larger resources for innovations, since they are riskier and will not bring return immediately.

As long as there is positive coefficient in front of the variable *PHD_R&D_EDUC* it should be concluded that there is positive linear relationship between the portion of directors on board with advanced technological expertise and R&D investment intensity. It might indicate that the more board member are able to fully comprehend complicated R&D issues sometimes requiring special knowledge and skills, the more likely the company will heavily invest in R&D. Furthermore, directors with not only technical or technological education background but also who have PhD are more likely to form community of academicians on board and establish

connections between companies, which they might use to more beneficial implementations of innovation strategies. In addition, directors with advanced technological expertise are more probably to follow new trends in technologies and monitor breakthroughs in science, the results of which they will be able to bring to the company and thus to direct its innovation activities and R&D investment in particular in definite directions.

If to comment on the results of other variables, it should be said that board size occurred to be negatively related to R&D investment intensity, which might be explained by the fact that big boards in spite of accumulating more experience and knowledge from different people suffer from lack of agreement. Supposedly, when there are a lot of directors with different opinions on such complicated issue as R&D investments it is harder to find consensus. As a result, directors being afraid to lose company's money behave themselves in a risk-averse manner and are less inclined to intensively invest in R&D.

What concerns financial leverage, it is turned out to be negatively related to R&D investment intensity as well. It can be attributed to the fact that usually company invest the excess of money in R&D neglecting the importance of innovations and do not borrow loans for that purpose, since R&D investment require a lot of financial resources and have long payback period and in case of failure may impose huge losses on company. Moreover, heavily indebted company is unlikely to allocate a lot of money for R&D, especially if it uses credits to finance current operating activities.

As for *COMPSIZE*, negative sign of the coefficient in front of the variables can be explained by the fact that for big corporations the share of R&D investments in sales is relatively much lower, since they have enormous sales, even if in absolute figures they spend on R&D more.

The results of the second regression model are presented below in the table:

Table 6

Results of regression analysis of the second model

Variable	ROA			
	Baseline model	Pooled regression	Fixed effects model	Random effects model
<i>RD</i>	-	0.069***	0.077***	0.074***
<i>RD</i> ²	-	-0.012**	-0.010**	-0.012***
<i>LEV</i>	-0.098***	-0.094***	-0.069**	-0.076***
<i>COMPSIZE</i>	0.013***	0.012***	0.029	0.012**

Variable	ROA			
	Baseline model	Pooled regression	Fixed effects model	Random effects model
<i>CONS</i>	-0.233**	-0.224**	-0.671	-0.236**
R^2	0.166	0.214	0.137	0.225
<i>p-value</i>	0.000	0.000	0.000	0.000
<i>N</i>	234	234	234	234

Note: *, **, *** indicate significance at 10%-, 5%-, 1% levels of significance respectively

Here all obtained models are statistically significant, and the choice according to the statistical tests is for random effects model. This way, based on the fact that coefficient in front of variables describing R&D investment intensity is different from 0 and negative for the variable in second power, we should accept the hypothesis number 1 that there is a nonlinear relationship between R&D investment intensity and firm performance. Thus, we may conclude that bringing innovation to company through which it reaches competitive advantage, R&D investments increase firm performance indicated by return on assets. However, after a certain proportion additional investments in R&D will not be able to contribute to performance, since company will not have enough resources to implement all innovations it obtained. Moreover, innovations are susceptible to copying innovations, and R&D investments as any other type of investments are characterized by diminishing return, which also contributes to nonlinear form of relationship.

This way, the highest ROA value is reached when relation between R&D expenses and sales achieves 2,875, which is depicted on the graph below:

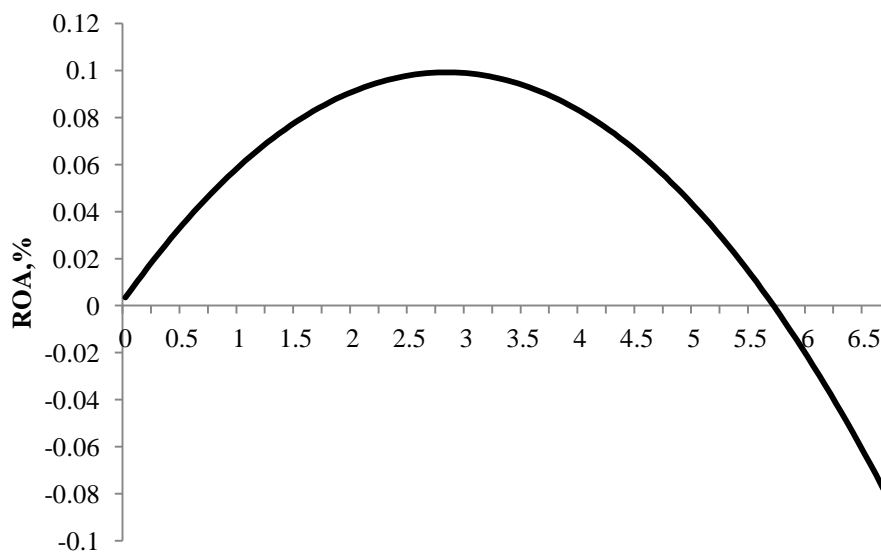


Figure 14. Relationship between R&D investment intensity and firm performance

However, taking into account the fact that only 5% of companies in the sample have the portion of R&D investments in sales equal or higher than 2,875 the relationship between R&D investment intensity and firm performance should be perceived as linear. It means that innovative Russian companies haven't reached the point, which will allow them to fully exploit benefits from innovations, about which we have already talked above, and that investments in R&D should become more intensive.

3.3. Analysis of results

The results of the research allow us to make a conclusion about the relationship between board's intellectual capital and firm performance in innovative companies. In particular in the course of doing this work it was found that there is nonlinear (inverted U-shape) relationship between board's tenure and R&D investment intensity. Supposedly, sitting for not very long period (as it was discovered up to 4 years) on the board, director gradually gains valuable knowledge about the industry, in which company operates, learns about firm's strong and weak points, opportunities for development in accordance with industry dynamic. Thus, he or she is inclined to invest more in R&D to increase company performance, since through R&D investments company obtains innovation, which are aimed at bringing to firm competitive advantage. However, after being a director for 4 years director starts keeping his or her status quo, unwilling to change anything, including invest in R&D, which may crucially change the company or in case of failure impose huge losses on it. This way, directors with longer tenure are less inclined to intensively invest in R&D.

It also was discovered that there is nonlinear (inverted U-shape) relationship between board's multiple directorships of nonexecutive directors and R&D investment intensity. In other words, without positions on other boards, directors is able to fully dedicate his activities to performing duties on the board of the company, but fails at bringing new ideas and knowledge from outside, since he or she is not exposed to external informational flows. However, when director starts occupying positions on seats of boards in other companies, he or she, enlarging his or her networks, gets access to valuable information and contacts, which may be of help for discovering new opportunities for the firm in terms of investment in R&D, which also may contribute to their successful implementation. The positive effect reaches its maximum at the point of 5 positions on other companies' boards. If to increase the number further, director will not be able to fully participate in the activities of all boards, he or she is sitting. Consequently, under the circumstances of limited time, he or she will not be willing to make out complicated technological issues connected to R&D, which are in addition risky and have longer payback

period in comparison with other investments. Thus, directors with more than 5 positions are likely to decrease R&D investment intensity with each next position.

The obtained results clearly show that board's tenure and multiple directorships should be viewed from standpoints of both agency theory and resource dependence one: benefits from exposure to additional resources go hand in hand with costs on monitoring and implementing them. The lack of comprehension of this notion may lead to erroneous interpretation of results obtained in studies on the topic of board's intellectual capital.

One more conclusion is that advanced technological expertise is positively related to R&D investment intensity. This way, it is confirmed that directors who have profound special education are more likely to pay attention to R&D investments, since it requires education prerequisites to make out the gist and potential benefits from investing in R&D. However, such directors are more likely not only to invest more in R&D, but also to define the right strategic directions for the investments. Forming networks of academicians will connect companies between each other and contribute to information circulation among them. Finally, academicians on board are more probably pay closer attention to scientific news, which might bring new technologies to the company. These results coincided with the ones obtained in (Swift, 2018), in which the author as well concludes that scientists in relevant chemical and physical fields are able to greatly enhance board's capability in terms of realizing R&D policies bringing especially valuable human and social capital.

It was found as well that there is nonlinear (inverted U-shape) relationship between R&D investment intensity and firm performance expressed by return on assets coefficient. However, because of lack of companies in the sample, whose portion of R&D investment in sales is more than value, at which ROA reaches its maximum (2,875), we should conclude that the relationship is linear. In other words Russian companies need to invest more R&D to reach the point, when firm performance will be at its highest value.

This way, we might conclude that there is nonlinear (inverted U-shape) relationship between board's tenure and firm performance, as well as there is nonlinear (inverted U-shape) relationship between multiple directorships of nonexecutive directors and firm performance, while advanced technological expertise positively relates to firm performance.

Based on the results described above it is logical to propose certain recommendations to innovative Russian companies in order to increase their performance. First of all, taking into account findings of current study as well as observations of practitioners in the field, it is advised to increase R&D investment intensity. As it was shown Russian companies are far from the point, in which the portion of R&D investments in sales starts ruining firm performance that is

why they should enhance investments in innovations till it reaches at least the average value of 6.7%. One of the tools to achieve it is to design board of directors whose composition will allow company to accumulate social and human capital that will contribute to more intensive investments in R&D as well as to successful implementation of those investments and overall innovation policy. It is particularly advised to invite members holding approximately 5 positions on board of other companies. Moreover, to increase investment in R&D, it is recommended to elect directors with advanced technological expertise or in other words those who not only have engineering or technical education background, but who did academic career in the field, obtaining PhD. Such directors will be able to thoroughly understand R&D activities, comprehend their potential and help with their implementation through wide network of contacts with other academicians. In addition, it is advised to maintain rotation of directors on board, letting their tenure not to exceed 4.5 years, since on average after that time directors become reluctant to innovate.

In order to facilitate the recommendations made above, it is proposed for innovative Russian companies to develop corporate governance code with a set of criteria for electing board members, which now exists in very few companies (e.g. PJSC RusHydro). This code will become a regulating document, in which there will special requirements to future board members such as: number of positions on other boards (approaching to 5), longest possible tenure (not more than 4.5 years) and to the board composition overall (including at least one member with advanced technological expertise: engineering education and PhD). Following such a recommendation will allow innovative Russian companies to fully exploit benefits from investment in R&D in terms of their return on assets, which is especially important for firms in engineering sector, which according to the findings recently experienced negative return on assets and companies from oil and chemical sector, since they seem to be more knowledge-intensive in comparison with other innovative industries in Russian economy. It also should be said that the proposed recommendations will be helpful not only for particular innovative companies, but as well for authorities, which with a view of the findings might start to oblige all companies to operate in accordance with corporate codes and requirements described above, starting with innovative companies as drivers of national economy. Moreover, these recommendations are addressed to shareholders and investors, who might use them deciding on the future investment decisions in the process of analyzing corporate governance of a target company. Finally, the recommendations may be found relevant by board members themselves, while accepting invitation to become director on the board of one more company. The obtained results might serve for them as a reference point and threshold according to which to choose the number of positions they occupy on boards and tenure they are going to spend on them.

All things considered, economic reality in the world and especially in Russia requires from companies to find new sources of competitive advantages. In order to obtain them firms should actively innovate, but to facilitate innovation processes starting from investments in R&D companies need to compose boards of directors with high level of intellectual capital, which in its turn is designed in accordance with recommendations of corporate governance code. This way, we see that innovative activities of a firm require innovative standards of corporate governance.

CONCLUSION

This paper was devoted to investigation of relationship between board's intellectual capital and firm performance in innovative Russian companies. Consequently, the research objective is to find the relationship between board's intellectual capital and firm performance. In the course of writing this study a set of tasks was completed.

The first chapter gives the definition of such terms as "innovation", "innovative company" and identifies R&D expenses as the most adequate indicator of innovation activities. Moreover, in this chapter it is explained that the final purpose of obtaining innovation is to capture competitive advantage. Finally, based on the relevant scientific literature analysis the hypothesis about nonlinear relationship between R&D investment intensity and firm performance is formulated.

In the second chapter starting with comprehending corporate governance mechanisms and board of directors' functions, we proceed with the definition of board's intellectual capital, describing that in comparison with overall company's intellectual capital it consists only of two elements, which are human capital and social capital. Further in the chapter the particular examples of the components which make up board's capital are cited. Finally, the chapter makes an analysis of studies investigating relationship between board's capital and R&D investment intensity, finding that the major importance in scientific literature is paid to board's tenure, education and multiple directorships.

The third chapter concentrates on empirical research itself, finding that among innovative companies the longest average board tenure (4.14 years) and major average portion of directors with advanced technological expertise (13.26%) are in oil and chemical companies, while the highest average number of positions of nonexecutive directors on other companies' boards (4) is obtained in energy sector. Obtained results might be attributed to the fact that oil and chemical sector is more knowledge-intensive in comparison with other investigated industries that is why it requires high concentration of advanced technological expertise as well as longer experience in the industry and wide knowledge about company specificities. The high number of nonexecutive directors positions on other board in energy sector is likely to be explained by the fact that all companies in Russia operating in this industry are owned (directly or indirectly) by PJSC RudHydro and PJSC FSK EES, which appoint the same directors to affiliated daughter companies. In addition, the lowest average ROA values (-2.25%), were found in engineering industry, which makes the results of current study especially helpful to them. Moreover, it was discovered that there is nonlinear relationship between board's tenure and firm performance, expressed in ROA ratio, which means that the maximum value of return on assets is achieved,

when tenure reaches 4.5 years. Thus, gaining knowledge about company and industry with the course of time after on average 4.5 years directors become unwilling to make changes preserving current state of affairs. Also it was found that there is nonlinear relationship between multiple directorships and firm performance. It implies that the maximum value of ROA ratio is reached, when directors on average obtain 5 positions on boards of other companies. This way, at the beginning getting access to valuable resources and informational flows with each next position approximately after obtaining 5th one director is likely to start lacking time to be fully immersed in each company's activities, thus worsening performance. What is more, it was confirmed that advanced technological expertise is positively related to firm performance, meaning that directors with engineering background who have PhD are likely contribute to R&D investment intensity and thus increase in firm performance. Finally, we discovered that in spite of the fact that generally the relationship between R&D investment intensity and firm performance is nonlinear, for Russian companies, it should be regarded as linear one, since not more than 5% of companies in sample reached the value of portion of R&D expenses in sales corresponding to the highest ROA value.

Thus, based on these findings several recommendations were made to innovative public Russian companies regarding composition of their boards. First of all, it is advised to establish in corporate code the longest possible tenure for directors, which should be close to 4.5 years, since afterwards directors become more unwilling to invest in R&D. Secondly, we recommend also to include in corporate code recommendations regarding the number of positions on other boards directors should occupy. To increase R&D investment it is proposed to elect those directors who hold approximately 5 seats on other boards. Thirdly, we recommend selecting board members who have technical or engineering educational background with PhD, which may contribute to more intensive investments in R&D as well as their successful implementation. Finally, Russian public companies are given advice to invest more intensively in R&D, since it is positively related to firm performance. Moreover, Russian companies underinvest in R&D in comparison with foreign companies and to use the benefits from innovation activities at full, firms in Russia should increase R&D investment intensity at least till the portion of expenses on R&D in sales reach the average value of 6.6%.

The developed recommendations are especially helpful to companies from engineering industry, since they recently suffered from negative return on assets, and firm belonging to oil and chemical sectors, for they seems to be more knowledge-intensive. However, the findings might be of help for authorities to introduce corporate governance code for all public companies, to shareholders and investors to analyze corporate governance while making investment decision and to directors themselves while deciding on their number of positions and tenure.

BIBLIOGRAPHY

1. Al-Matari, Ebrahim Mohammed, Abdullah Kaid Al-Swidi, and Faudziah Hanim Bt Fadzil. "The measurements of firm performance's dimensions." *Asian Journal of Finance & Accounting* 6, no. 1 (2014): 24-49.
2. Annual report of PJSC AVTOVAZ for 2016 (2018). Retrieved from *Info.Avtovaz.Ru*. <http://info.avtovaz.ru/index.php?id=186>.
3. Annual report of PJSC «Kazan'orgsintez» for 2016 (2018). Retrieved from *Kazanorgsintez.Ru*. <https://www.kazanorgsintez.ru/about/information/godovye-otchety.php>.
4. Annual report of PJSC MMC Norilsk Nickel for 2016 (2018). Retrieved from *Ar2016.Nornik.Ru*. <https://ar2016.nornik.ru/ru>.
5. Annual report of PJSC NC Rosneft' for 2016 (2018). Retrieved from *Rosneft.Ru*. https://www.rosneft.ru/upload/site1/document_file/a_report_2016.pdf.
6. Ashwin, A. S., Rishiksha T. Krishnan, and Rejie George. "Board Characteristics, Financial Slack and R&D Investments: An Empirical Analysis of the Indian Pharmaceutical Industry." *International Studies of Management & Organization* 46, no. 1 (2016): 8-23.
7. Bae, Sung C., and Seungwook Noh. "Multinational corporations versus domestic corporations: a comparative study of R&D investment activities." *Journal of multinational financial management* 11, no. 1 (2001): 89-104.
8. Balashov A., Rogova E., Tkachenko E. "Innovative activities of Russian firms: problems of measurement and growth conditions." (2010)
9. Balsmeier, Benjamin, Achim Buchwald, and Heiko Peters. *Outside board memberships of CEOs: Expertise or entrenchment?*. No. 26. DICE discussion paper, 2011.
10. Barsukova A., Kot V. and Kozlov V. Small innovation locomotive. (2018). Retrieved from <http://expert.ru/south/2012/20/malenkij-innovatsionnyij-lokomotiv/>
11. Baysinger, Barry, and Robert E. Hoskisson. "The composition of boards of directors and strategic control: Effects on corporate strategy." *Academy of Management review* 15, no. 1 (1990): 72-87.
12. Beld, Bart. "The effects of R&D investment on firm performance." Bachelor's thesis, University of Twente, 2014.
13. Berezinets, Irina, Tatiana Garanina, and Yulia Ilina. "Intellectual capital of a board of directors and its elements: introduction to the concepts." *Journal of Intellectual Capital* 17, no. 4 (2016): 632-653.

14. Berezinets, Irina, Yulia Ilina, and Anna Cherkasskaya. "Board structure, board committees and corporate performance in Russia." *Managerial Finance* 43, no. 10 (2017): 1073-1092.
15. Booth-Bell, Darlene. "Social capital as a new board diversity rationale for enhanced corporate governance." *Corporate Governance: The International Journal of Business in Society* (2018).
16. Booth, James R., and Daniel N. Deli. "Factors affecting the number of outside directorships held by CEOs." *Journal of Financial Economics* 40, no. 1 (1996): 81-104.
17. Bouras, Mehdi, and Mohamed Imen Gallali. "Managerial Ownership, Board of Directors, Equity-based Compensation and Firm Performance: A Comparative Study between France and the United States." *Mediterranean Journal of Social Sciences* 8, no. 1 (2017): 78-95.
18. Bravo, Francisco, and Nuria Reguera-Alvarado. "The effect of board of directors on R&D intensity: board tenure and multiple directorships." *R&D Management* 47, no. 5 (2017): 701-714.
19. Buchwald, Achim, and Susanne Thorwarth. *Outside directors on the board, competition and innovation*. No. 173. DICE Discussion Paper, 2015.
20. Bukhvalov A.V., Smirnov M.V. Corporate governance: introductory course (2012).
21. Bugeja, Martin, Raymond Da Silva Rosa, and Andrew Lee. "The impact of director reputation and performance on the turnover and board seats of target firm directors." *Journal of Business Finance & Accounting* 36, no. 1-2 (2009): 185-209.
22. Burja, Vasile, and Radu Mărginean. "The study of factors that may influence the performance by the Dupont analysis in the furniture industry." *Procedia Economics and Finance* 16 (2014): 213-223.
23. Bushman, Robert, Qi Chen, Ellen Engel, and Abbie Smith. "Financial accounting information, organizational complexity and corporate governance systems." *Journal of Accounting and Economics* 37, no. 2 (2004): 167-201.
24. Chauvin, Keith W., and Mark Hirschey. "Advertising, R&D expenditures and the market value of the firm." *Financial management* (1993): 128-140.
25. Chen, Hsiang-Lan. "Board Characteristics and R&D Investment: Evidence from Taiwan's Electronics Industry." *Advances in Management and Applied Economics* 2, no. 4 (2012): 161.
26. Chen, Hsiang-Lan, and Wen-Tsung Hsu. "Family ownership, board independence, and R&D investment." *Family business review* 22, no. 4 (2009): 347-362.

27. Chubais became co-owner of Rosnano (2018): Retrieved from <http://expert.ru/2014/01/16/chubajs-stal-sovladeltsem-uk-rosnano/>
28. Coles, Jeffrey L., and Chun-Keung Hoi. "New evidence on the market for directors: Board membership and Pennsylvania Senate Bill 1310." *The Journal of Finance* 58, no. 1 (2003): 197-230.
29. Corporate governance code from 21.03.2014 V: Vestnik of Russian Bank № 40 (1518) (2018) Retrieved from <http://www.cbr.ru/publ/Vestnik/ves140418040.pdf>
30. Corporate governance guide book V. 6, P.1 "Introduction to corporate governance" prepared and published International financial corporation M: "Alpina Busines Books", (2004)
31. Corporate governance: history and practice (2018). Retrieved from http://www.cbr.ru/sbrfr/archive/fsfr/ffms/ru/legislation/corp_management_study/index.html
32. Corporate governance. (2018). Retrieved from http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+CG
33. Dalziel, Thomas, Richard J. Gentry, and Michael Bowerman. "An integrated agency–resource dependence view of the influence of directors' human and relational capital on firms' R&D spending." *Journal of Management Studies* 48, no. 6 (2011): 1217-1242.
34. Deloitte. "Тройка за управление", (2018). Retrieved from <https://www2.deloitte.com/ru/ru/pages/about-deloitte/deloitte-in-press/2016-year/korporativnoe-upravlenie.html#>
35. Dong, Jing, and Yan-nan Gou. "Corporate governance structure, managerial discretion, and the R&D investment in China." *International Review of Economics & Finance* 19, no. 2 (2010): 180-188.
36. Doukas, John, and Lorne Switzer. "The stock market's valuation of R&D spending and market concentration." *Journal of Economics and Business* 44, no. 2 (1992): 95-114.
37. Driver, Ciaran, and Maria João Coelho Guedes. "Research and development, cash flow, agency and governance: UK large companies." *Research Policy* 41, no. 9 (2012): 1565-1577.
38. Drucker, Peter. *Innovation and entrepreneurship*. Routledge, 2014.
39. Fama, Eugene F., and Michael C. Jensen. "Separation of ownership and control." *The journal of law and Economics* 26, no. 2 (1983): 301-325.
40. Federal law from 26.05.1995 N 208-FL (2018). Retrieved from http://www.consultant.ru/document/cons_doc_LAW_177708/

41. Federal law from 28.09.2010 N 244-FL (2018) Retrieved from <http://kremlin.ru/acts/bank/31792>
42. Ferris, Stephen P., Murali Jagannathan, and Adam C. Pritchard. "Too busy to mind the business? Monitoring by directors with multiple board appointments." *The Journal of finance* 58, no. 3 (2003): 1087-1111.
43. Fich, Eliezer M., and Anil Shivdasani. "Financial fraud, director reputation, and shareholder wealth." *Journal of Financial Economics* 86, no. 2 (2007): 306-336.
44. Filatov A. Board of directors work organization. Practical recommendations *Alpina Publisher* (2014): 172.
45. Financial report of OJSC AVTOVAZ for 2013 (2018). Retrieved from <https://www.e-disclosure.ru/portal/files.aspx?id=31&type=3>
46. Gazin G. Corporate governance in Russia: real competitive advantage. «Vestnik McKinsey» (2018). Retrieved from <http://vestnikmckinsey.ru/organizational-models-and-management-systems/korporativnoe-upravlenie-v-rossii-real-noe-konkurentnoe-preimushhestvo>
47. Gilson, Ronald J., and Reinier Kraakman. "Reinventing the outside director: An agenda for institutional investors." *Stanford Law Review* (1991): 863-906.
48. Gu, Yuqi, and Ling Zhang. "Busy Directors and Corporate Innovation." *Journal of Business and Educational Leadership* 6, no. 1 (2016): 49.
49. Harris, Milton, and Artur Raviv. "A theory of board control and size." *The Review of Financial Studies* 21, no. 4 (2006): 1797-1832.
50. Hbr-russia.ru5 problems of Russian innovations or why does all go in the wrong way. . (2018). Retrieved from <http://hbr-russia.ru/innovatsii/upravlenie-innovatsiyami/p16595/>
51. He, Q., Chen, S. and Zhang, J., 2010, July. An empirical study of board education's distribution and R&D expenditure from listed manufacturing firms in China. In *Technology Management for Global Economic Growth (PICMET), 2010 Proceedings of PICMET'10*: (pp. 1-6). IEEE.
52. Hill, Charles WL, and Scott A. Snell. "External control, corporate strategy, and firm performance in research-intensive industries." *Strategic management journal* 9, no. 6 (1988): 577-590.
53. Hill, Charles WL, and Scott A. Snell. "External control, corporate strategy, and firm performance in research-intensive industries." *Strategic management journal* 9, no. 6 (1988): 577-590.

54. Hillman, A.J. and Dalziel, T., 2003. Boards of directors and firm performance: Integrating agency and resource dependence perspectives. *Academy of Management review*, 28(3), pp.383-396.
55. Ho, Yew Kee, Mira Tjahjapranata, and Chee Meng Yap. "Size, leverage, concentration, and R&D investment in generating growth opportunities." *The Journal of Business* 79, no. 2 (2006): 851-876.
56. Honoré, Florence, Federico Munari, and Bruno van Pottelsberghe de La Potterie. "Corporate governance practices and companies' R&D intensity: Evidence from European countries." *Research policy* 44, no. 2 (2015): 533-543.
57. Hoskisson, Robert E., Michael A. Hitt, Richard A. Johnson, and Wayne Grossman. "Conflicting voices: The effects of institutional ownership heterogeneity and internal governance on corporate innovation strategies." *Academy of Management journal* 45, no. 4 (2002): 697-716.
58. Innovations – the way to increase performance. *Vestnikmckinsey.ru*. (2018) Retrieved from <http://vestnikmckinsey.ru/strategic-planning/innovacii-put-k-povyhsheniyu-ehffektivnosti>
59. Instruction for filling the form of federal state statistic observation № 4 – Information about organization's innovation activities", *approved by a decision of State Statistics of Russia. 22.07.2002 №156*
60. Jackling, Beverley, and Shireenjit Johl. "Board structure and firm performance: Evidence from India's top companies." *Corporate Governance: An International Review* 17, no. 4 (2009): 492-509.
61. Jensen, Michael C., and William H. Meckling. "Theory of the firm: Managerial behavior, agency costs and ownership structure." *Journal of financial economics* 3, no. 4 (1976): 305-360.
62. Jiraporn, Pornsit, Manohar Singh, and Chun I. Lee. "Ineffective corporate governance: Director busyness and board committee memberships." *Journal of Banking & Finance* 33, no. 5 (2009): 819-828.
63. Kaminskaite, J. and Kaminskaite, J. (2018). Top 10 Most Innovative Industries. *Global Innovation Management Institute (GIM Institute)*. Retrieved from <https://www.giminstitute.org/top-10-most-innovative-industries/>
64. Klein, April. "Firm performance and board committee structure." *The Journal of Law and Economics* 41, no. 1 (1998): 275-304.

65. Kor, Yasemin Y. "Direct and interaction effects of top management team and board compositions on R&D investment strategy." *Strategic Management Journal* 27, no. 11 (2006): 1081-1099.
66. Kor, Yasemin Y., and Chamu Sundaramurthy. "Experience-based human capital and social capital of outside directors." *Journal of Management* 35, no. 4 (2009): 981-1006.
67. Korolev V.A. Role of board of directors in the context of ownership structure "Independent director" (2018) Retrieved from <http://ncda.ru/library/articles/board/boardrole/>
68. Lei, Adrian CH, and Jie Deng. "Do multiple directorships increase firm value? Evidence from independent directors in Hong Kong." *Journal of International Financial Management & Accounting* 25, no. 2 (2014): 121-181.
69. Lin, Bou-Wen, and Ja-Shen Chen. "Corporate technology portfolios and R&D performance measures: a study of technology intensive firms." *R&D Management* 35, no. 2 (2005): 157-170.
70. Listing rules - best international practices (2018) Retrieved from <http://ipoguide.moex.com/section-1-3.html>
71. López Iturriaga, Félix J., and Ignacio Morrós Rodríguez. "Boards of directors and firm performance: the effect of multiple directorships." *Spanish Journal of Finance and Accounting/Revista Española de Financiación y Contabilidad* 43, no. 2 (2014): 177-192.
72. Maassen, Gregory Francesco. *An international comparison of corporate governance models: A study on the formal independence and convergence of one-tier and two-tier corporate boards of directors in the United States of America, the United Kingdom and the Netherlands*. No. 31. Gregory Maassen, 1999.
73. Malysheva L.A., Shestalov I.V. Analysis of approaches to innovation activities of Russian companies. *Vestnik of Perm national research polytechnic university. Social-economic sciences*, no 14 (2012).
74. Mank, Del A., and Halvard E. Nystrom. "Decreasing returns to shareholders from R&D spending in the computer industry." *Engineering Management Journal* 13, no. 3 (2001): 3-8.
75. Manual, Frascati. "Proposed standard practice for surveys on research and experimental development." (2002).
76. Manukov S. When innovations lead to nothing. *Forbes.ru*. (2018). Retrieved from <http://forbes.ru/2017/10/17/pochemu-innovatsii-ni-k-chemu-ne-privodyat/>
77. Marr, Bernard, and Göran Roos. "A strategy perspective on intellectual capital." *Perspectives on intellectual capital* (2005): 28-52.

78. Masulis, Ronald W., and Shawn Mobbs. "Independent director incentives: Where do talented directors spend their limited time and energy?." *Journal of Financial Economics* 111, no. 2 (2014): 406-429.
79. Masulis, Ronald W., Cong Wang, and Fei Xie. "Globalizing the boardroom—The effects of foreign directors on corporate governance and firm performance." *Journal of Accounting and Economics* 53, no. 3 (2012): 527-554.
80. Midavaine, Jeanelle, Wilfred Dolfsma, and Rick Aalbers. "Board diversity and R & D investment." *Management Decision* 54, no. 3 (2016): 558-569.
81. Mohamed, Azman, A. Rasli, and NN Abu Mansor. "Business impact and ROI: a proposed approach to learning and development investment." *Procedia-Social and Behavioral Sciences* 40 (2012): 596-603.
82. Mortensen, Peter Stendahl, and Carter Walter Bloch. *Oslo Manual-Guidelines for Collecting and Interpreting Innovation Data: Proposed Guidelines for Collecting and Interpreting Innovation Data*. Organisation for Economic Cooperation and Development, OECD, 2005.
83. Nishi, Takahiro. "Corporate diversification and board composition in Japanese electronics corporations." *International Journal of Business and Management* 3, no. 2 (2015): 27-44.
84. Open government offers to decrease tax burden for companies in innovation field (2018) Retrieved from <http://www.vedomosti.ru/technology/articles/2016/03/28/635281-otkritoe-pravitelstvo-predlagaet-uluchshit-nalogovie-usloviya-dlya-kompanii-innovatsionnoi-sfere>
85. Pantagakis, Emmanouil, Dimitrios Terzakis, and Stavros Arvanitis. "R&D investments and firm performance: An Empirical Investigation of the High Technology Sector (Software and Hardware) in the EU." (2012).
86. Pearce, John A., and Shaker A. Zahra. "Board composition from a strategic contingency perspective." *Journal of management studies* 29, no. 4 (1992): 411-438.
87. Pfeffer, Jeffrey, and Gerald R. Salancik. "The external control of organizations: A resource dependence approach." *NY: Harper and Row Publishers* (1978).
88. PJSC Gazprom Board of Directors report about top activities directions (2018) Retrieved from <http://www.gazprom.ru/about/management/directors/report/>
89. Pombo, Carlos, and Luis H. Gutiérrez. "Outside directors, board interlocks and firm performance: Empirical evidence from Colombian business groups." *Journal of Economics and Business* 63, no. 4 (2011): 251-277.

90. Porter, Michael E. *Competitive strategy: Techniques for analyzing industries and competitors*. Simon and Schuster, 2008.
91. Praznichnyh A.N. Building innovative economy for future *Russian journal of management* no 2 (2013): 107-150.
92. Quantitative composition of board of directors(2018) Retrieved from https://www.cfin.ru/management/strategy/orgstr/directors_board.shtml#1_2
93. Rahman, Md Musfiquir, and Naima Khatun. "Intellectual Capital: A Review from the Literature." *Journal of Industrial Distribution & Business* Vol 7, no. 4 (2016): 5-9.
94. Romano, Giulia, and Andrea Guerrini. "The effects of ownership, board size and board composition on the performance of Italian water utilities." *Utilities Policy* 31 (2014): 18-28.
95. Ruigrok, Winfried, Simon I. Peck, and Hansueli Keller. "Board characteristics and involvement in strategic decision making: Evidence from Swiss companies." *Journal of management Studies* 43, no. 5 (2006): 1201-1226.
96. Salancik, Gerald R., and Jeffrey Pfeffer. "A social information processing approach to job attitudes and task design." *Administrative science quarterly* (1978): 224-253.
97. Sarri, Katerina, Elpida Samara, Ioannis Bakouros, and Paraskevi Giourka. "Innovativeness in SMEs: Exploring the role of Marketing Innovation." *The New Knowledge Globalization Era: Future Trends Changing Corporate and Marketing Communications* (2011): 432.
98. Schumpeter, Joseph, and Ursula Backhaus. "The theory of economic development." In *Joseph Alois Schumpeter*, pp. 61-116. Springer, Boston, MA, 2003.
99. Science. Technologies. Innovations. Innovations activities. (2018). Retrieved from https://issek.hse.ru/data/2017/11/14/1161223955/NTI_N_73_15112017.pdf
100. Seemann, Patricia, David DeLong, S. Stukey, and Edward Guthrie. "Building intangible assets: a strategic framework for investing in intellectual capital." *Knowledge management: Classic and contemporary works* (2000): 85-98.
101. Shakina, Elena, Angel Barajas, and Mariya Molodchik. "Bridging the gap in competitiveness of Russian companies with intangible bricks." *Measuring Business Excellence* 21, no. 1 (2017): 86-100.
102. Stevenson, William B., and Robert F. Radin. "Social capital and social influence on the board of directors." *Journal of Management Studies* 46, no. 1 (2009): 16-44.
103. Strategy of Russian innovation development till 2020: confirmed by order of Governemnt of the Russian Federation from 08.12.2011 N 2227 (2018). Retrieved from <http://innovation.gov.ru/taxonomy/term/58631792>

104. Structures of corporate governance in public Russian companies *Research of the center of corporate governance Deloitte*(2018). Retrieved from <http://www2.deloitte.com/ru/ru/pages/risk/articles/2016/corporate-governance-structures-of-public-russian-companies.html>
105. Swift, Tim. "PhD scientists in the boardroom: the innovation impact." *Journal of Strategy and Management* 11, no. 2 (2018): 184-202.
106. Sulinska, Iwona Magdalena. "Complexities of Social Capital in Boards of Directors." PhD diss., Copenhagen Business School (Phd), 2018.
107. Surgutneftegas replaces directors. (2018). Retrieved from <https://www.kommersant.ru/doc/2398612>
108. Szewczyk, Samuel H., George P. Tsetsekos, and Zaher Zantout. "The valuation of corporate R&D expenditures: Evidence from investment opportunities and free cash flow." *Financial Management* (1996): 105-110.
109. Tejedo-Romero, Francisca, Joaquim Filipe Ferraz Esteves Araujo, and Magnus Luiz Emmendoerfer. "Corporate governance mechanisms and intellectual capital." *Revista brasileira de gestão de negócios* 19, no. 65 (2017): 394-414.
110. Volkov D. L. Value-based management and the problem of choosing an adequate model of estimation *Bulletin of Saint-Petersburg State University. Management* no 4 (2004): 79-98.
111. Volonté, Christophe. "Boards: Independent and committed directors?." *International review of law and economics* 41 (2015): 25-37.
112. Wincent, Joakim, Sergey Anokhin, and Daniel Örtqvist. "Does network board capital matter? A study of innovative performance in strategic SME networks." *Journal of Business Research* 63, no. 3 (2010): 265-275.
113. Why innovations in Russia have a chance. *The newspaper RBC*. (2018) Retrieved from <https://www.rbc.ru/newspaper/2017/10/06/59d63bcc9a79470fdb573107>
114. Yoo, Taeyoung, and Taeyoon Sung. "How outside directors facilitate corporate R&D investment? Evidence from large Korean firms." *Journal of Business Research* 68, no. 6 (2015): 1251-1260.
115. Yudanov A.Y. What is innovative firm? *Questions of economics*. no 7. (2012): 30-46.
116. Zahra, Shaker A., and John A. Pearce. "Boards of directors and corporate financial performance: A review and integrative model." *Journal of management* 15, no. 2 (1989): 291-334.

117. Zhu, Zhaohui, and Feng Huang. "The effect of R&D investment on firms' financial performance: Evidence from the Chinese listed IT firms." *Modern Economy* 3, no. 08 (2012): 915.

APPENDICES

Appendix 1. Descriptive statistics of variables in the first model

Variable	Obs	Mean	Std. Dev.	Min	Max
tenurebd	234	3.323721	1.979889	.5	10.2778
phd_rd_educ	234	.1048463	.1218453	0	.533333
bd_size	234	9.183761	2.590092	4	15
compsize	234	24.60281	2.114075	18.3325	29.6836
lev	234	.506392	.2599422	.00297	1.0643
state1	234	.0783497	.1168665	0	.533333
rd	234	.1300808	.6646328	5.00e-08	6.72326
nonex_busy~w	234	2.402505	2.370332	0	10.1

Appendix 2. Descriptive statistics of variables in the second model

Variable	Obs	Mean	Std. Dev.	Min	Max
compsize	234	24.88158	2.116004	19.09715	30.03643
leverage	234	.5633479	.382944	.0018549	2.915128
roa	234	.0266694	.1158786	-.6626172	.4766021

Appendix 3. Regression results of the first model: baseline model

. reg rd compsize lev

Source	SS	df	MS	Number of obs = 234		
Model	8.61731095	2	4.30865548	F(2, 231) = 10.55		
Residual	94.3073611	231	.408256974	Prob > F = 0.0000		
				R-squared = 0.0837		
				Adj R-squared = 0.0758		
Total	102.924672	233	.44173679	Root MSE = .63895		

rd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	-.0682974	.0198775	-3.44	0.001	-.1074618	-.0291331
lev	-.540092	.1616611	-3.34	0.001	-.8586106	-.2215733
_cons	2.083888	.5046445	4.13	0.000	1.089594	3.078182

Appendix 4. Regression results of the first model: model 1

. reg rd compsize lev bd_size nonex_busy_now

Source	SS	df	MS	Number of obs = 234		
Model	10.2100508	4	2.5525127	F(4, 229) = 6.30		
Residual	92.7146212	229	.404867342	Prob > F = 0.0001		
				R-squared = 0.0992		
				Adj R-squared = 0.0835		
Total	102.924672	233	.44173679	Root MSE = .63629		

rd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	-.0620596	.0228212	-2.72	0.007	-.1070258	-.0170933
lev	-.5373669	.1620644	-3.32	0.001	-.8566948	-.218039
bd_size	-.0212798	.0185842	-1.15	0.253	-.0578977	.015338
nonex_busy~w	.0301958	.0179923	1.68	0.095	-.0052557	.0656474
_cons	2.051558	.5120658	4.01	0.000	1.042595	3.060521

Appendix 5. Regression results of the first model: model 2

```
. reg rd compsize lev bd_size nonex_busy_now nonex_busy_now2
```

Source	SS	df	MS	Number of obs = 234		
Model	12.8946144	5	2.57892288	F(5, 228) = 6.53		
Residual	90.0300576	228	.394868674	Prob > F = 0.0000		
				R-squared = 0.1253		
				Adj R-squared = 0.1061		
Total	102.924672	233	.44173679	Root MSE = .62839		

rd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	-.0527722	.0228173	-2.31	0.022	-.097732	-.0078124
lev	-.5136543	.1603088	-3.20	0.002	-.8295305	-.1977781
bd_size	-.0250419	.0184099	-1.36	0.175	-.0613171	.0112334
nonex_busy_w	.1164221	.037541	3.10	0.002	.0424505	.1903937
nonex_busy_~2	-.0119733	.004592	-2.61	0.010	-.0210215	-.0029251
_cons	1.774475	.516748	3.43	0.001	.7562632	2.792688

Appendix 6. Regression results of the first model: model 3

```
. reg rd compsize lev bd_size nonex_busy_now nonex_busy_now2 phd_rd_educ
```

Source	SS	df	MS	Number of obs = 234		
Model	18.6716056	6	3.11193427	F(6, 227) = 8.38		
Residual	84.2530664	227	.371158883	Prob > F = 0.0000		
				R-squared = 0.1814		
				Adj R-squared = 0.1598		
Total	102.924672	233	.44173679	Root MSE = .60923		

rd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	-.0655646	.0223581	-2.93	0.004	-.1096205	-.0215088
lev	-.4414495	.1564953	-2.82	0.005	-.7498188	-.1330802
bd_size	-.035521	.0180452	-1.97	0.050	-.0710784	.0000365
nonex_busy_w	.1162266	.0363965	3.19	0.002	.0445084	.1879449
nonex_busy_~2	-.012797	.0044569	-2.87	0.004	-.0215792	-.0040148
phd_rd_educ	1.377238	.3490906	3.95	0.000	.6893659	2.065111
_cons	2.014134	.5046632	3.99	0.000	1.019711	3.008558

Appendix 7. Regression results of the first model: model 4

```
. reg rd compsize lev bd_size nonex_busy_now nonex_busy_now2 phd_rd_educ tenurebd
> d
```

Source	SS	df	MS	Number of obs = 234		
Model	18.7609878	7	2.68014111	F(7, 226) = 7.20		
Residual	84.1636843	226	.372405683	Prob > F = 0.0000		
				R-squared = 0.1823		
				Adj R-squared = 0.1570		
Total	102.924672	233	.44173679	Root MSE = .61025		

rd	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	-.0620671	.023506	-2.64	0.009	-.1083859	-.0157482
lev	-.4376931	.1569454	-2.79	0.006	-.7469565	-.1284297
bd_size	-.0374449	.0184971	-2.02	0.044	-.0738938	-.000996
nonex_busy_w	.1141513	.0367029	3.11	0.002	.0418277	.1864749
nonex_busy_~2	-.0126622	.0044729	-2.83	0.005	-.0214761	-.0038484
phd_rd_educ	1.414888	.3580218	3.95	0.000	.7094004	2.120376
tenurebd	-.0108178	.0220812	-0.49	0.625	-.0543292	.0326935
_cons	1.97928	.510492	3.88	0.000	.9733468	2.985212

Appendix 8. Regression results of the second model: baseline model

```
. reg roa compsize leverage
```

Source	SS	df	MS	Number of obs = 234		
Model	.542439622	2	.271219811	F(2, 231) = 24.22		
Residual	2.58624952	231	.011195885	Prob > F = 0.0000		
				R-squared = 0.1734		
				Adj R-squared = 0.1662		
				Root MSE = .10581		
Total	3.12868915	233	.01342785			

roa	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
compsize	.0126723	.0032926	3.85	0.000	.006185	.0191596
leverage	-.0979556	.0181934	-5.38	0.000	-.1338019	-.0621092
_cons	-.2334542	.0838631	-2.78	0.006	-.3986885	-.0682198

Appendix 9. Regression results of the second model: pooled regression

```
. reg roa rd rd_2 compsize leverage
```

Source	SS	df	MS	Number of obs = 234		
Model	.714626496	4	.178656624	F(4, 229) = 16.95		
Residual	2.41406265	229	.010541758	Prob > F = 0.0000		
				R-squared = 0.2284		
				Adj R-squared = 0.2149		
				Root MSE = .10267		
Total	3.12868915	233	.01342785			

roa	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
rd	.0688514	.0170381	4.04	0.000	.0352799	.1024229
rd_2	-.0117002	.0036538	-3.20	0.002	-.0188996	-.0045008
compsize	.012033	.0032159	3.74	0.000	.0056964	.0183696
leverage	-.0944418	.0178927	-5.28	0.000	-.1296972	-.0591864
_cons	-.2244809	.081742	-2.75	0.007	-.3855435	-.0634183

Appendix 10. Regression results of the second model: fixed effects model

```
. xtreg roa rd rd_2 compsize leverage, fe
```

Fixed-effects (within) regression	Number of obs	=	234
Group variable: n	Number of groups	=	67
R-sq: within = 0.1372	Obs per group: min	=	1
between = 0.1922	avg	=	3.5
overall = 0.1817	max	=	5
	F(4,163)	=	6.48
corr(u_i, Xb) = -0.3567	Prob > F	=	0.0001

roa	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
rd	.0765466	.0176401	4.34	0.000	.0417141	.111379
rd_2	-.0104312	.0038366	-2.72	0.007	-.0180071	-.0028552
compsize	.0293493	.0359164	0.82	0.415	-.041572	.1002707
leverage	-.0690332	.0274177	-2.52	0.013	-.1231728	-.0148937
_cons	-.6710876	.8932	-0.75	0.454	-2.434822	1.092647
sigma_u	.0841176					
sigma_e	.0898402					
rho	.46713905	(fraction of variance due to u_i)				

F test that all u_i=0: F(66, 163) = 2.06 Prob > F = 0.0001

Appendix 11. Regression results of the second model: random effects model

```
. xtreg roa rd rd_2 compsize leverage, re
```

```
Random-effects GLS regression              Number of obs      =       234
Group variable: n                          Number of groups   =        67

R-sq:  within = 0.1333                    Obs per group: min =         1
       between = 0.2247                               avg =        3.5
       overall = 0.2251                               max =         5

corr(u_i, X)  = 0 (assumed)                Wald chi2(4)       =       49.18
                                           Prob > chi2        =       0.0000
```

roa	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
rd	.0739901	.016182	4.57	0.000	.042274	.1057062
rd_2	-.0117225	.0034186	-3.43	0.001	-.0184229	-.0050221
compsize	.0121306	.0043526	2.79	0.005	.0035996	.0206616
leverage	-.0785751	.019674	-3.99	0.000	-.1171356	-.0400147
_cons	-.2360184	.1096988	-2.15	0.031	-.4510241	-.0210126
sigma_u	.05470827					
sigma_e	.0898402					
rho	.27051027	(fraction of variance due to u_i)				

Appendix 12. Regression results of the second model: Breusch-Pagan test

```
. xttest0
```

Breusch and Pagan Lagrangian multiplier test for random effects

$$\text{roa}[n,t] = Xb + u[n] + e[n,t]$$

Estimated results:

	Var	sd = sqrt(Var)
roa	.0134279	.1158786
e	.0080713	.0898402
u	.002993	.0547083

Test: $\text{Var}(u) = 0$

$\text{chibar2}(01) = 13.79$
 Prob > chibar2 = 0.0001

Appendix 13. Regression results of the second model: Hausman test

```
. hausman fe re
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
rd	.0765466	.0739901	.0025565	.0070225
rd_2	-.0104312	-.0117225	.0012913	.0017415
compsize	.0293493	.0121306	.0172187	.0356517
leverage	-.0690332	-.0785751	.0095419	.0190961

b = consistent under H_0 and H_a ; obtained from xtreg
 B = inconsistent under H_a , efficient under H_0 ; obtained from xtreg

Test: H_0 : difference in coefficients not systematic

$\text{chi2}(4) = (b-B)' [(V_b-V_B)^{-1}] (b-B)$
 = 1.40
 Prob>chi2 = 0.8444